THE AMERICAN GAS LIGHT JOURNAL

REDMAN & KENNY, N.Y.

PUBLISHING OFFICE No. 42 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

VOLUME XLVIII.—No. 12. Whole No. 696. | NEW YORK, SATURDAY, JUNE 16, 1888 | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager.
JOS. H. THOMAS, C.E., Editor. T. J. CUNNINGHAM, Asst. Editor.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y. AS SECOND CLASS MATTER.

Published on the 2d and 16th of each month, at No. 42 Pine Street, N. Y.

Terms of Subscription, Including Postage.—For the United States and Canada, $3 per annum. European countries, $3.50 (15 shillings—18 francs). All payments to be made in advance. Single copies, 15 cents.

Remittances should be made either by post-office order, registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

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WE are sorrowfully compelled to announce the death of Mr. Wm. Helme, of Philadelphia, Pa. This sad stroke occurred on last Wednesday. In our next we hope to give a history of his busy and honorable life.

BRIEFLY TOLD.

THE ACTION OF THE MASSACHUSETTS LEGISLATURE.—On May 29th the Governor of Massachusetts gave his official sanction to two measures which have been contended for strenuously over several sessions of the Legislature, and which contention has been met by well organized opposition. One of these measures, entitled an "Act in Relation to the Bay State Gas Company," is worth putting on record merely to insure it a place in which it can be found at any time by any reader of the JOURNAL who, from motive of business or curiosity, may in future wish to reperuse it. The Act, which is registered in Chap. 427 of the laws of the Commonwealth of Massachusetts, in relation to the Bay State Gas Company, is as follows:

"SEC. 1.—The Bay State Gas Company is hereby authorized to increase its capital stock to an amount not exceeding $2,500,000, subject to the provisions of the general laws, and the approval of the Board of Gas Commissioners. Such additional stock to be issued from time to time in such amounts as the said Board may determine to be necessary or expedient to carry into effect the objects for which said Company was organized." Then follows the usual notice of when the act shall become effective, which, in this case, happens to be immediately.

The gentlemen behind the scenes in the Bay State Company modestly asked for the right to issue five millions of capital—just twice the amount which the proprietors of the old Boston Company have found ample for all the purposes of their business—to carry on an opposition gas supply in Boston; but failing in this, they quietly accepted one-half of their demand, probably on the principle that half of the loaf would sustain them better than the complete absence of bread. The laws of the State are peculiar in their prescription as to how capital may be raised; and we think they are illogical. However, the State at large has decided that Boston shall be burdened with twice the capital amount necessary to supply Boston's citizens with gas, and there is an end of it—at least until the Bostonians come, in the future, to count the cost to them of their Legislature's easy prodigality in the matter of arming foreign capital to earn its interest in their midst. We cannot refrain from pointing out the latent irony of the words of the Act which prescribe that the new stock is to be issued "from time to time in such amounts as the said Board may determine to be necessary or expedient to carry into effect the objects for which said Company was organized." Gas men throughout the country will perhaps share in a broad smile at the leniency of a paternal government which fosters the schemers of outsiders at the expense of its own adherents. The "objects" of the promoters of the Bay State Company were—what? Ostensibly to give Boston cheaper gas than that which was sold there; practically, to coerce the owners of the old Boston Company into either sale or surrender.

The second measure, however, is one which will interest not only the gas makers of this country, but those in other countries as well. Massachusetts some years ago placed on her statute books a law for the better protection of the health and the lives of her citizens, which consisted simply of the declaration that no illuminating gas that contained over 10 per cent. of carbonic oxide should be distributed within her boundaries. The State Board of Health, the members whereof cared neither for the interests of the Boston Gas Company nor those of the Bay State corporation, declared the law was a good one; and, further, they proved it, by means of well and intelligently conducted experiment. Despite the records, made during the last 5 years, of deaths in other States from the inhalation of illuminating gas, which are strangely voluminous when compared with similar returns from Massachusetts, we now find that the reigning Solons, unable to resist the pressure from without, have decreed that the Massachusetts gas death list shall have equal chance to keep pace with those of other States. At any rate, Chap. 428 of the laws of Massachusetts (1888), approved on May 29, reads as follows:

"SEC. 1.—The Board of Gas Commissioners is hereby authorized to license any gas company now authorized to make gas for illuminating

purposes to make and sell water gas for illuminating purposes containing any percentage of carbonic oxide that said Board may determine; provided that such Board shall be of opinion and certify in any license granted by them that in their opinion the gas so authorized can be used with safety for such purposes; and after receiving such license said company shall be exempt from any penalty or prohibition provided in section 14, chap. 61 of the Public Statutes relating to carbonic oxide, provided the percentage of carbonic oxide shall not exceed the limit allowed by said Board.

"SEC. 2.—Any company which shall, under the provisions of the first section of this act, be licensed to make and sell water gas for illuminating purposes containing an excess of 10 per cent. of carbonic oxide, shall furnish to every actual consumer a copy of the Gas Commissioner's license, which shall contain a statement of the percentage of carbonic oxide such gas contains, as near as the same can be ascertained. And no company so licensed shall charge more for water gas in any locality than is charged in that locality by any company furnishing gas therein when the manufacture and sale of such water gas is so licensed."

Time was when the legislators of the Bay State would not seek to cast upon other shoulders the responsibiiity for their own acts. And right here we would say that the safety of the Massachusetts Gas Commission —a body which is fast winning its way in the affections of local gas consumers, and also is rapidly overturning the prejudice in which it was held by those of the gas fraternity who originally opposed the formation of such Commissions—is imperilled by the foisting upon it of duties like those imposed by this oddly-pieced bit of legislation. If water gas is to be made and sold in Massachusetts, remove all hindrances like those set forth; or else appoint the State Board of Health as the arbitrators. The Gas Commission was not intended to usurp the functions of the sanitary authority; and, if we mistake not, none of its members claims to be an authority on toxicology. Indeed, the whole drift of the measure is as greatly calculated to weaken the Commission as it is designed to facilitate the manufacture and sale of water gas. However, they themselves have said it, and in the way they did say it the lawmakers are to be congratulated on the thoroughness with which they succeeded in begging the question.

DEATH OF MR. JOHN C. PRATT.—Death has so far this year held high carnival in the ranks of the gas makers, the last fatal shaft being aimed at a well-known and highly esteemed member of the fraternity—Mr. Jno. C. Pratt, of the Jamaica Plain district of the city of Boston. Deceased was born in Boston in March, 1813, and the whole of his busy, useful, and honorable life was spent in his native city. His early training was gained in Boston's public schools, which have turned out thousands of mentally well equipped youngsters to do honorable battle with the men of their times. In 1833 deceased entered the office of H. H. Hunnewell, of Wellesley, in whose service he soon attained high rank. On the death of Mr. Hunnewell, Mr. Pratt continued to act as manager of the Hunnewell and Weld estates, which position he retained until his death. The latter, it should have been said, occurred on the 7th inst. Mr. Pratt was always prominently identified with railroad enterprises, having been the original President of the old Little Rock and Fort Smith Railroad Company, and for 15 years (1864 to 1879) acted as President of the Ogdensburg and Lake Champlain system. Even at the time of his death he was in railroad harness, filling the position of chief executive of the Granite Railway Company. Other positions of trust honorably accounted for by him were those of the Presidency of the Jamaica Plain Savings Bank and in the Directorate of the Franklin Insurance Company. Despite these calls on his services, Mr. Pratt often found leisure to contribute to the press articles principally devoted to railway and financial topics, and he never wavered in his adherence to the dogmas of the baptist creed, of which religion he was a pronounced and practical devotee. The fraternity, however, knew him best from his connection with the Jamaica Plain Gas Light Company, which enterprise owed its formation to his sagacity. The Company was chartered in 1853, and Mr. Pratt was named by his brother Directors to fill its Presidential chair, to which office he had been re-elected for 35 successive terms. Mr. Pratt was a pronounced believer in the good policy of revealing to gas consumers everything connected with the business of those who were catering to their lighting needs, and the annual accounts of the Jamaica Plain Gas Company were as an open book to its customers. Deceased was elected to membership in the American Gas Light Association at the 7th annual meeting, held in Philadelphia, October, 1879. He was a frequent contributor to the literary and oral portions of the Association's sessions, and never cloaked his meaning in the presentation of a subject. He was the last surviving member of the initial Board of Directors of the Jamaica Plain Company, which has lost a true and tried servitor in his demise. He had been in failing health for a year or more—a patient sufferer from a painful and lingering malady—but the fortitude that accompanied him in his more vigorous years remained with him to the last. He leaves a widow and four sons. The funeral services were celebrated last Monday, when a large gathering assembled to bid final farewell to a friend and patron whose memory shall be to them at once a comfort and an aid.

WE have also to record the death of Mr. Albert F. Upton, which sad event occurred at his home in Newtonville, Mass., on the 8th inst. Deceased, who was well known to the fraternity from his connection with the Jarvis Engineering Company, had been in failing health for some time back, and finally succumbed to an attack of brain paralysis. He was in his 45th year, but had already attained signal eminence in many forms of practical engineering; his greatest proficiency, perhaps, having been achieved in connection with electricity.

THE PHILADELPHIA PROPOSALS.—When Mayor Fitler and Director Wagner were confronted with the figures submitted in the first competition for the right to remove the coal tar produced on the Corporation Gas Works they were, to our mind, justly indignant over the prices offered. As said in our last, the authorities determined to re-advertise for new tenders, which action it was thought would be contested by the highest bidders—the Messrs. Stellwagon—in the first instance. On the 5th inst. the second attempt at competition disclosed a state of affairs which goes far to justify (if further justification were needed) our previous remarks about the rapacity of the kings of the Tar Trust. When the bids were opened it was seen that the Stellwagons had retired from the contest, leaving the Messrs. Ehret, Jr., & Co. in complete possession of the field, who simply renewed their former offer to take the tar for one year on the basis of 20 cents per ton of coal carbonized, or to pay 21½ cents per ton if allowed to perform the work for three years. Truly, the last state of the Corporation, then, was worse than the fix it was in at first; but the authorities without seeming difficulty swallowed the pill, and authorized the Messrs. Ehret & Co. to walk off with the spoils for a term of three years. We confess to feeling that the spurt of virtuous indignation on the part of the authorities was easily quieted, and that the retirement of the Stellwagons, who offered to pay 26½ cents for a 3-year contract in the original contest, appears to have acted sensibly and potently on the erstwhile disturbed nerve centers of the agitated representatives of the city. And we do not think the Stellwagons will occupy any great share of the time of the local courts in attempting to break the bargain.

The true inwardness of the formation (in Camden, N. J.) last May of the Philadelphia Gas Improvement was also brought to light at the time the tar contract was awarded. Prior to the opening of the tar bids, Mayor Fitler, in the presence of the Finance and Gas Committees of Councils, opened bids for supplying the city with a quantity of gas, not to exceed 3,000,000 cu. ft. per day, in accordance with the advertisement which has hitherto appeared in the JOURNAL. As it was with the tar so also was it with the gas supply. There was only one bidder—the afore-mentioned New Jersey Company—but this bidder could and would supply any sort of gas wanted. The city might take its choice out of any of the four following propositions:

Flannery Process.—Candle power (minimum in all instances), 22; carbonic oxide content (maximum in each), 26 per cent.; price per 1,000 cu. ft., 45 cents; royalties, 2½ cents per 1,000; estimated cost of works, $250,000.

Motay and Jerzmanowski Process.—Candle power, 30; carbonic oxide, 26 per cent.; price per 1,000, 48 cents; royalties, 3½ cents per 1,000; cost of works, $500,000.

Hanlon and Ledley Process.—Candle power, 22; carbonic oxide, 24½ per cent.; price per 1,000, 37 cents; royalties, 2½ cents per 1,000; cost of works, $275,000.

Springer Process.—Candle power, 22; carbonic oxide, 25 per cent.; price per 1,000, 42 cents; royalties, 2½ cents per 1,000; cost of works, $465,000.

Mr. J. Edward Addicks, Chairman of the Flannery Gas Patent Company (Limited), sent in a communication in which he explained that he did originally propose to bid on this supply, but subsequently concluded to allow the New Jersey Company to bid for him. The Mayor thought they were confronted by "but one bidder with several processes;" and it is hard to see what other conclusion his Honor could have reached, under the circumstances. It was finally decided to refer the multiple bid to a sub-committee of the Council's Committee; and thus the matter rests, at least so far as we know.

IT is said that the East Newark (N. J.) Gas Light Company is about to relinquish its plant on Passaic avenue.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

On a Visit East.—The astute President of the Laclede Gas Light Company—Capt. Jno. P. Keiser—has made a tour South and East for the purpose of inspecting the various systems of electric lighting now in practical operation in many of the larger cities—perhaps we ought to have said that he is making a tour; for, although he left St. Louis on the 5th inst., his route, as originally mapped out, included stoppages at New Orleans, Baltimore, New York, Boston, etc. Hence, despite the fact that forced marches have no terrors for the Capt., the magnificent distances to be covered will probably keep him on the "go" for some weeks. In connection with the Company's determination to engage in the electric lighting business, we can say that the Directors have purchased a substantial three-storied building (southwest corner of Mound street and the Levee) on a plot of ground just back of the site of the present gas works. We understand the intention is to install a plant equal to the maintenance of 1,000 arc lights, to which ultimately may be added a large incandescent plant.

Postponing the Hearing.—As stated before, certain residents of that district of Boston supplied with gas by the Roxbury Gas Light Company petitioned for a hearing before the Gas Commissioners, the object being to secure a reduction in the rates charged. The return day of the notice was fixed for the 22d ult., at which time the petitioners and representatives of the Company appeared before the Commissioners and united in asking for a continuance to July 10th. The Board granted the adjournment. From the nature of the remarks since made by those interested in the matter, it is quite likely that there will be slight difference of opinion between the consumers and the Company on the adjourned date In other words, the Roxbury Company will agree to make an equitable concession in rates prior to July 10th. We congratulate them on their decision, if so it is in reality; for this is the season when molasses is much more attractive than vinegar—even to the disgruntled gas consumer.

Lawrence (Mass.) Does not Seem to Feel It Much.—Agent Humphreys, of the Lawrence Gas Light Company, does not appear to be coddling the electric lighting portion of the Company's business at the expense of the carburetted hydrogen division of his complete, in both respects, system for catering to the lighting necessities of his busy bailiwick. Figures tell the tale, however; and when we say that 25 per cent. more gas was sold in Lawrence last month than in the corresponding month of 1887, we think enough has been said to prove our initial assertion. This, of course, is a decidedly abnormal increase; but even admitting that last May was amazingly like the type described by Mr. Jas. Russell Lowell as one of the Mays that Mayn't, still, even with a normal proportion of good May weather allowed for, Agent Humphreys has good reason to be satisfied with what his record book shows. And other gas men will be satisfied, too, with what those figures teach.

We are sorry to tell his many friends that Mr. Samuel Fowler, so well known from his long and honorable connection with the Westfield (Mass.) Gas and Electric Light Company, is fast losing his strength, in consequence of the rapid strides being made by the insidious disease which has so painfully warped a once vigorous frame. While hoping for the best, we sadly fear that his exhausted vitality will not much longer repel the shock. His son, Mr. Samuel F. Fowler, is now acting as Secretary and Treasurer of the Company.

The Montreal (Can.) Gas Company has given out a contract for enlarging a single-lift holder to a double one at its Ottawa works. This will afford some relief. We understand that the Directors of the Company are thinking seriously of the advisability of insuring the lives of their employes.

Another Gas Company.—It is said that the Common Council of Superior (Wis.) have granted a franchise to Thos. Hennessy for the operation of a gas works at this point, provided the work of construction is immediately proceeded with. The grantee has filed a bond in $10,000 for the performance of his contract. Superior is in Douglas county, at the west end of Lake Superior, close to or on the mouth of the Nemadji river, and is 7 miles Southeast of Duluth. This place must have enjoyed a marvelous growth within the last decade to be equal to the task of now supporting a gas company.

Supt. Boynton, of the Chicopee (Mass.) Gas Light Company, is to be congratulated on the fact that the accident which recently happened to the holder at that point resulted in no greater damage. Perhaps it would be a wise move on the part of the Chicopee Company's proprietors to put up a new holder. At the rate at which their make of gas is increasing this action cannot be much longer deferred.

At the annual meeting of the United Gas Improvement Company (held on 4th inst.) the following Officers and Directors were re elected: President, Geo. Philler; Vice-President, W. W. Gibbs; General Manager, A. O. Granger; Sec. and Treas., Samuel T. Bodine; Assist. Sec. and Treas., Edward C. Lee. Directors, Messrs. G. W. Philler, W. W. Gibbs, T. Dolan, J. A. Wright, H. C. Gibson, S. T. Bodine, S. H. Caldwell, W. M. Singerly, W. T. Carter.

Mr. H. N. Anderson, of Greenville, Mich., has purchased the local gas plant, which, as noted in our last, had been put on the market by its owner, Mrs. H. M. Fuller. Mr. Anderson will operate the plant on his own account. If we mistake not, Mr. Anderson will have no reason to regret his action.

In the death of Professor Aiken, whose conservative and honorable direction of his office (as Inspector of gas and illuminating oils for the city of Baltimore, Md.) covered a period of over a score of years, Baltimore loses a most efficient and praiseworthy servant. Mayor Latrobe has named Prof. Pierce W. Wilson to fill the vacancy.

Contracts Recently Secured by the National Gas Company.—The National Gas Light and Fuel Company has scant cause for complaint in respect of the amount of business thus far awarded it this season. The Company is now engaged on the following contracts:

Locality, etc.	Capacity of Plant.
Shelbyville (Ind.) Gas Light Co.	80,000 cu. ft.
Northwestern Gas Lt. and Coke Co., Evanston, Ills.	80,000 "
Great Falls (N. H.) Gas Light Co.	80,000 "
Belleville (Ont.) Gas Light Co.	120,000 "
Rochester (Minn.) Light and Fuel Co.	175,000 "

Annual Election, Georgetown, D. C.—The proprietors of the Georgetown Gas Light Company, despite the lumbering efforts of certain Senatorial dignitaries to interfere with their property, had small reason for complaint when the annual reports of the year's business had been spread before them on June 4th. No thanks for the results shown were awarded to the aforesaid dignitaries, however. The annual election terminated in the following selections: President, John Leetch; Secretary, G. W. Cropley; Superintendent, J. D. Cathell; Directors, W. F. Seymour, J. Marbury, J. Smoot, T. Knowles, W. B. Orme, S. T. Brown, and G. W. Cropley. It is likely that improvements will be made at this point.

The contract existing between the city of Newark, N. J., and the local gas companies permits this year of a revision of the prices named in it. The Superintendent of Public Lighting (Mr. William Chenoweth) will urge that the hours of public lighting be increased from the present schedule (3,300 hours per annum) to 3,650 hours. The sittings for revision will be held next month; and the contract provides that if the Lighting Committee and the Companies fail to agree on terms, arbitrators are to be called in whose decision shall be final.

Louis Wyler, F. M. Riegel and Sam Aub, a majority of the Directors of the Heilbrun Light and Fuel Company, of Cincinnati, Ohio, have filed a petition in the local Court of Common Pleas for the dissolution of the Company. Judge Robertson appointed Samuel Wolfenstein referee, and ordered him to report back to the Court on September 3d. This concern was organized with a great flourish of trumpets (with the modest capital of $300,000, of which $5,000 was paid in), and proposed to revolutionize the gas industry of Ohio through the medium of the A. Heilbrun patents. The Ohio gas men still live; but, strange to say, the assets of the would-be revolutionizers, as inventoried by the above-named majority of the Directors, consist of the Heilbrun patent parchment, about 300 gas burners, a gas meter, and "three account books." Quite an embarrassment of riches.

Going to do Battle.—The proprietors of the Memphis Gas Light Company propose to make it warm for the philanthropists—who would like to buy out the old Company. The following is a transcript of a portion of the minutes of a meeting of the Directors of the old Company, held towards the close of last month: "*Resolved*, That the Memphis Gas Light Company hereby announces to its patrons and the public that being fully equipped by recent improvement of its works, it will furnish gas as good in quality and cheap in price as can be furnished by any competing company." Hold out to the bitter end in this declaration, Messrs. Directors, and perhaps the philanthropists will finally ask for grace—meaning the crumbs. An equitable division of the territory is, of course, out of the question.

ELECTION, SOUTH SIDE GAS COMPANY.—At an election held by the proprietors of the South Side Gas Company (Pittsburgh, Pa.), on May 29th, the following officers were chosen: President, Geo. Trautman; Secretary, W. H. Alldred; Treasurer, W. L. Elkins, Jr. Directors, G. Trautman, M. Maloney, G. W. Elkins, J. S. Dickson, J. G. Walter, W. H. Alldred, Jos. Stewart, R. V. Messler and R. B. Brown.

NEW GAS COMPANY.—Olathe, Kansas, is to have gas, Messrs. W. B. Newry and others having incorporated the Olathe Gas, Coal and Mining Company. The enterprise starts out with a capital of $10,000. This town is the capital of Johnson county, and is on two well-equipped railway lines. It is about 32 miles south of Leavenworth, and 21 miles southwest of Kansas City. The venture ought to prove a profitable one, because the location bids fair to become quite a business center.

PUBLIC LIGHTING, MILWAUKEE, WIS.—The bids submitted to the City Council for the public lighting of Milwaukee for a term of 5 years were opened on June 1st. The Milwaukee Gas Light Company offered to maintain 2,000 gas lamps (5-ft. burners) for the sum of $26.08 each per annum; the rate to be increased to $29.89 if 6-ft. burners were decided upon. The Northwestern Electrical Construction and Supply Co. would furnish 2,000-candle power arcs, at the rate of $130 each per year. The Badger Illuminating Company asked $115 per annum for 1,200-candle power arcs, or $150 for those of the 2,000-candle power variety, in districts where poles could be used, the figure to be increased to $175 in districts where underground wires must be employed. The bids were taken under advisement.

IN THE MARKET.—A. A. Richardson, Consulting Engineer (headquarters at Lincoln, Neb., to which address all communications on the subject must be sent), asks for proposals for the construction of a complete system of water works for the town of Chadron, Nebraska. The competition closes on June 26. This place is in the north-central portion of Dawes county, and is about 5 miles south of Wyoming Junction, on the White river. H. M. Farnsworth, Village Clerk, Brooklyn, Ohio, asks for proposals for furnishing and putting down about 6,500 feet of 4-inch cast iron pipe. He also asks for figures on specials, etc. He will receive bids up to June 26.

A FORTNIGHT ago the Engineers' Club, of Philadelphia, held a most interesting session. Secretary Murphy presented, on behalf of Mr. W. S. Sheafer, a series of valuable notes on the coal deposits of Sonora, Mexico. If Mr. Sheafer is not very wide of the mark, these coal-beds ought soon to figure prominently in the commerce of that section. Having said that the deposit consists of a good grade of anthracite, and that the mines were easily accessible by rail, the author concluded his notes in the following analysis presentation: Fixed carbon, 80.17; moisture, 8.45; volatile matter, 6.05; ash, 5.33. Of course these figures, save in respect of the percentage of ash reported, do not develop any exceptionally intrinsic valuable properties in the coal tested; but the mere fact that a fairly good free-burning anthracite exists in the region mentioned should give great encouragement to those in the States not far from the location of the Sheafer discovery. For example, explorers in the Lone Star State have industriously sought for anthracite deposits, being tempted thereto by the ease with which lignite veins are encountered in different sections; yet their pertinacity has only been rewarded by the uncovering of one seam—that in Palo Pinto county, near Gordon—the product of which shows a fixed carbon content in excess of 60 per cent. Dr. Edgar Everhart, Prof. of Chemistry at the University of Texas, in a very careful analysis (made, we believe, in 1886), thus estimates the nature of the Palo Pinto article: Fixed carbon, 63.54; volatile matter, 32.64; ash, 2.86; water, 0.86; sulphur, 0.25. Many mining experts believe that the discovery of good anthracite in Texas is merely a question of time and endurance; and the prospectors may take renewed hope in the discoveries of Mr. Sheafer—although these did occur in Mexico.

MR. GEROULD'S FIRST MOVE.—Not long since it was our pleasant task to say that Mr. L. P. Gerould, formerly of Manchester, N. H., had so far recovered his health and spirits as to enable him to accept the position of Manager and Superintendent of the Monmouth (Ills.) Gas Light Company. That he means to be Manager in the fullest sense of the term is shown in the move taken by the Company on the 1st inst., from which date the proprietors agree to furnish gas at the gross rate of $2.50 per thousand. If bills are settled within 10 days from presentation a rebate of 50 cents per thousand takes effect. Gas at $2 per thousand is pretty cheap for a town situated like Monmouth; but even that rate will be cut in the near future. We congratulate Messrs. Foley and Gerould on their unity of opinion in respect of the best policy to be pursued in the ownership and management of a gas works.

THE TRUE INWARDNESS OF THE CHANGES AT ATCHISON, KANSAS.—In our last we made brief mention of certain gaseous and electrical happenings at Atchison, Kansas; and to that hint we now are, through the courtesy of a correspondent, enabled to add the following: "It was common rumor this Spring that negotiations were in progress for the incorporation of a new lighting company which was to take over the respective franchises and plants of the Atchison Gas Company and the local electric light company. Rumor, as is often the case, was right; for on May 19 the Atchison Gas, Electric Light and Power Company succeeded to the estates of the separate companies. The new enterprise is so in name only, as will be readily understood by those acquainted with the personnel of the old Atchison Gas Company, for the Board of Directors of the consolidated enterprise contains the following familiar names: J. P. Pomeroy, A. G. Otis, James M. Chisham, J. P. Brown, and E. S. Wills. The officers are: President, J. P. Pomeroy; Vice-President, A. G. Otis; Treasurer, R. A. Park; Secretary and Superintendent, James M. Chisham. In fact, from a view of the foregoing, it is easy to predict that gas consumers will not feel as if they had fallen among strangers when they visit the office to settle their accounts. The deeds assert that the Atchison Electric Light and Power Company transferred to the Atchison Gas, Electric Light and Power Company all its franchises, real estate, and effects, for the sum of $50,000, and that the Atchison Gas Company turned over its property to the same receiver, for a consideration of $200,000. It is the intention of the proprietors to make an extensive series of improvements and enlargements in both divisions of their property, to the end that consumers can have their demands answered with ease and certainty. I understand that an incandescent plant is to be a feature of the electrical annex. The people of the city seem to be well pleased with the transfer of the light of the future to the hands of the gas men; for, if the truth must be told, the manner in which the supply of electric light was carried on here originally was far from satisfactory. Messrs. Pomeroy and Chisham, however, never do anything by halves; and in this knowledge Atchisonites rest content that they are going to have the best.—C. M. S."

ANNUAL ELECTION, CAMDEN, N. J.—The annual election of the Camden Gas Light Company resulted in the following choices: Directors, Messrs. B. F. Archer, Chas. Watson, Wm. Helme, S. C. Cooper and Richard F. Smith; who organized by naming the following executive management: President, B. F. Archer; Secy. and Treas., Chas. Watson. These are all re-elections. The Company is very prosperous, and deservedly so.

AN American Company—the Brush, we believe—has taken a contract to light the streets of Morelia, the capital of one of the States of Mexico, with electric lamps.

PUBLIC LIGHTING, BINGHAMPTON, N. Y.—The contract for lighting the streets of Binghampton, under a mixed system—gas and electricity—has been awarded to the Binghampton Gas and Electric Light Company. The Company agreed to supply arcs at the rate of 40 cents each per night, lights to burn every night and all night—under the old contract 50 cents was paid, the lamps being kept in duty 25 nights per month. The gas portion of the service is to be paid for at the rate of $23.75 per post, or about 6½ cents per post per night. The bid of the New York and New Jersey Globe Gas Light Company was no lower than that submitted by the local Gas Company. The Binghampton *Republican* thinks the gas men have acted in a most liberal spirit; and it looks as if the newsman was right.

ELSEWHERE we note that a gas company has been incorporated in Superior, Wis. This incorporation is all the more significant from the fact that a branch of the Daft Company is now supplying incandescent electric lighting there. We understand that consumers pay 89 cents per month for each 16-candle Daft lamp used.

MESSRS. J. MOORE, D. A. Henry and F. P. Slade have incorporated the Thomson-Houston Electric Light and Power Company, of Rockaway; but they propose to do business in Hempstead, L. I. The concern is capitalized in $75,000. This looks somewhat like a strike, because the Hempstead Gas Light Company (of which one of the renowned firm of Harper Bros., publishers, is the controlling spirit) has been supplying the electric current to the villagers for some time back. There is certainly not room enough in Hempstead for two companies—that is, on a business basis.

THE Keene (N. H.) Gas and Electric Light Company intends to add an incandescent branch to its present arc outfit.

THE Hausse Electric Light Company promoters have long been promising to start up at Chattanooga that wonderful plant of theirs; but time grows apace, and the lamps are still dim. Supt. Wiltsie now excuses the failure on the ground that the boiler foundation is defective, and then (as it seems to us) reflects rather severely on the local building talent, by saying he had to send to Cincinnati to secure the services of an expert to rebuild it. Chattanooga is to be pitied if her local masons are unable to satisfactorily reconstruct a boiler foundation. They might do well (provided Mr. Wiltsie is correct in his judgment) to take a few additional degrees in their business.

DOWN TO BED ROCK.—The proprietors of the Spencer (Mass.) Gas Company have issued a notice to their consumers that, from and after the first prox., they are to be supplied with gas at the net rate of $1 per thousand cubic feet. Judge Hill evidently does not mean to be defeated in his attempts to place the gas business at Spencer on a paying basis. We hope his courage will be rewarded, although it is now almost an open secret that (with gas of the quality manufactured) the prevailing $1.25 rate brings no profit to the Company. Our information in this regard seems to be unimpeachable; but should it happen that our informant's views are improperly grounded, we shall be pleased to print a correction from the pen of Judge Hill.

THE City Council of Memphis, Tenn., is investigating the policy of fitting up a station and employing an officer whose duty shall be to determine the candle power and quality of the gas supplied by the local companies.

THE new holder now being constructed by the Kalamazoo (Mich.) Gas Light Company, the capacity of which is rated at 80,000 cu. ft., will insure storage facilities for 148,000 cu. ft. The gas men in the city whose enemies must have presided at its baptism took some long chances last winter in the matter of holder room; or, rather, in the lack of it.

THE construction work on the Tallahasse (Fla.) gas plant is being vigorously pushed. The walls are well along, and President Crill has seen to it that the supply of materials is kept well ahead of the demands of the workmen—quite an important item when it is remembered that gentlemen of color have to be depended upon to lay the bricks and elevate the hod. The Tallahasse works are designed to produce 80,000 cu. ft. per diem.

ANNUAL ELECTION, WILLIMANTIC, CONN.—The election for officers in the Willimantic Gas Company was to have been held in Bristol, R. I., but subsequently the place was changed to Newport. The following is the result: President, Col. A. P. Sherman; Treas. and Supt., J. Howard Manchester; Secretary, C. H. Manchester; Directors, A. P. Sherman, J. C. Swan, J. H. Tilley, R. B. Franklin, J. L. Hunter, and A. Manchester.

TO ENTER THE ELECTRIC FIELD.—At a meeting of the stockholders of the City Gas Light Company, Norfolk, Va., held June 5th, it was decided to put in an electric light plant of the Thomson-Houston type. The plant is to be equal to the supplying of 150 commercial lights. The Directors prepared themselves for a movement of this sort something like 3 years ago, at which time they applied to the Legislature for an extension of their charter which would permit them at their pleasure to engage in the combined business. Those who want artificial light in Norfolk ought to be hard to please if the City Gas Company cannot suit them; for Supt. Bates has long been in a position to give them either water or coal gas, to which, in a few weeks, he will add the arc and incandescent styles of lamps.

GAS POWER FOR ELECTRIC LIGHTING STATIONS.—It is not in accordance with our custom or rule to call attention to advertisements that appear in our columns; but we will depart in this instance from that course, and because we believe the particular advertisement referred to—that of Messrs. Schleicher, Schumm & Co., of Philadelphia, the agents in this country for the Otto gas engine—can be read with interest and digested with profit by every member of the fraternity. When Mr. Keller read his paper, at the Chicago session of the Western Gas Association, on the cost of electric arc lighting the consensus of opinion, whispered rather than spoken, was that the author's figures—if the latter erred at all—were far too favorable for his side of the case; yet now we are confronted by figures, made, it is true, by one who can hardly be said to speak from an entirely independent position, but who, nevertheless, has yet to be convicted of falsification in respect of any statement put forward by him in the matter of the ability of the Otto gas engine to perform certain work at a stated expense, that put Mr. Keller's estimates far in the background. Speaking for ourselves, we believe that electric lighting stations allied to gas plants can be operated cheaply and efficiently with gas engines, which may be of the Otto type, or not, just as the inclination of the user prompts him. The pity is that gas motors are held at such high figures; but we presume the inventor is entitled to reap the full benefit of his ingenuity; although we think his reward, in money, would be far greater did he trust for his recompense to more extended sales rather than to a higher percentage on a more restricted distribution. The Otto folks do not consider this matter of the employment of gas engines for driving dynamos as belonging still to the field of experiment. And it would seem as if they were justified in the belief, for the gas companies at Spencer, Mass., Nashua, N. H., Washington, Ind., and Raleigh, N. C., are now using them for the above-named purpose. The last-named Company is operating one 50-horse power engine, and its work has been so well performed that the Company expects soon to duplicate the plant.

THE Chelsea (Mass.) Board of Aldermen have granted permission to the Gas Company to erect poles in the city's streets for the purpose of extending its electric lighting supply system.

IT is said that Messrs. A. P. Burgwin, L. H. Matthews, J. G. Hayes, E. Logan and W. A. Schmidt, who are said to "be all lawyers, associated with D. T. Watson in his office," intend to organize the Oriental Gas Company for the purpose of supplying both natural and illuminating gas to the city of Pittsburgh. Those who live in this section of the country have been for some time under the impression that the *ci-devant* Smoky City was plentifully supplied with depots for the distribution of all sorts of gases; but as lawyers are ever on the alert to supply a long-felt want, we suppose they only wish to put money in their purse—by hook or by crook.

A CONCERN known as the Empire Gas Manufacturing Company has been incorporated. Its projectors propose to operate in Syracuse, N. Y., provided capital can be induced to support the venture; but if the moneyed men of the Saline City are wise they will have none of it. At any rate before they subscribe they should inquire of Messrs. Hayes and Rider, of Norwich, N. Y., as to the feasibility of the Empire Company's process. As we understand the details of the Empire system, the latter is based on the idea of converting kitchen ranges, or even ordinary cook stoves into gas works. Those conversant with ancient history will have no trouble in recalling similar schemes that were tried in the long ago.

MESSRS. FRINK & HAYES applied some time ago to the authorities of Provincetown, Mass., for the right to operate a gas works in that town. The Selectmen thereupon appointed a committee to investigate the conditions under which gas was being supplied in other Eastern places of similar size, in the course of which study they visited Pittsfield and Farmington, N. H. Their report to the Selectmen was quite interesting, and they close their recital by saying that "Provincetown ought not to give Messrs. Frink & Hayes the right to dig up the streets, as the New Hampshire experience had shown these men to have no capital, their chief business being to procure franchises and dispose of them where they can make the most money." But the Committee also made some inquiries in regard to the feasibility of using electric light in Provincetown, and their conclusions in this instance were as follows: "We have consulted with different parties—among others representatives of the Thomson-Houston and Edison Companies—and find that where there are a large number of takers it is a success, otherwise it is a very expensive light. We would not recommend its use here at present." The town meeting held to consider this report voted that the Selectmen should grant the right to dig up the streets to the gas company applying therefor that should seem to the Selectmen most likely to avail itself of the permit. Satisfactory bonds are required, and work must be begun on the streets, and at least $1,000 spent on the works, within 6 months from the issuance of the permission. The permit cannot be transferred without the indorsement of the Selectmen, who also retain the right to issue subsequent permits for the use of the streets to rival electric light or gas companies. This lengthy mention of the action taken by the residents of one end of Barnstable county is made simply to show how careful some Massachusetts folks are when dealing with the gas question. Other residents of the same State are not nearly so particular; and it might be well if they were.

MR. CHAS. A. LEARNED has been appointed Assistant Superintendent of the East Boston, Mass., Gas Company.

THE parties who secured a gas and electric light franchise for Vineyard Haven, Mass., are said to mean business.

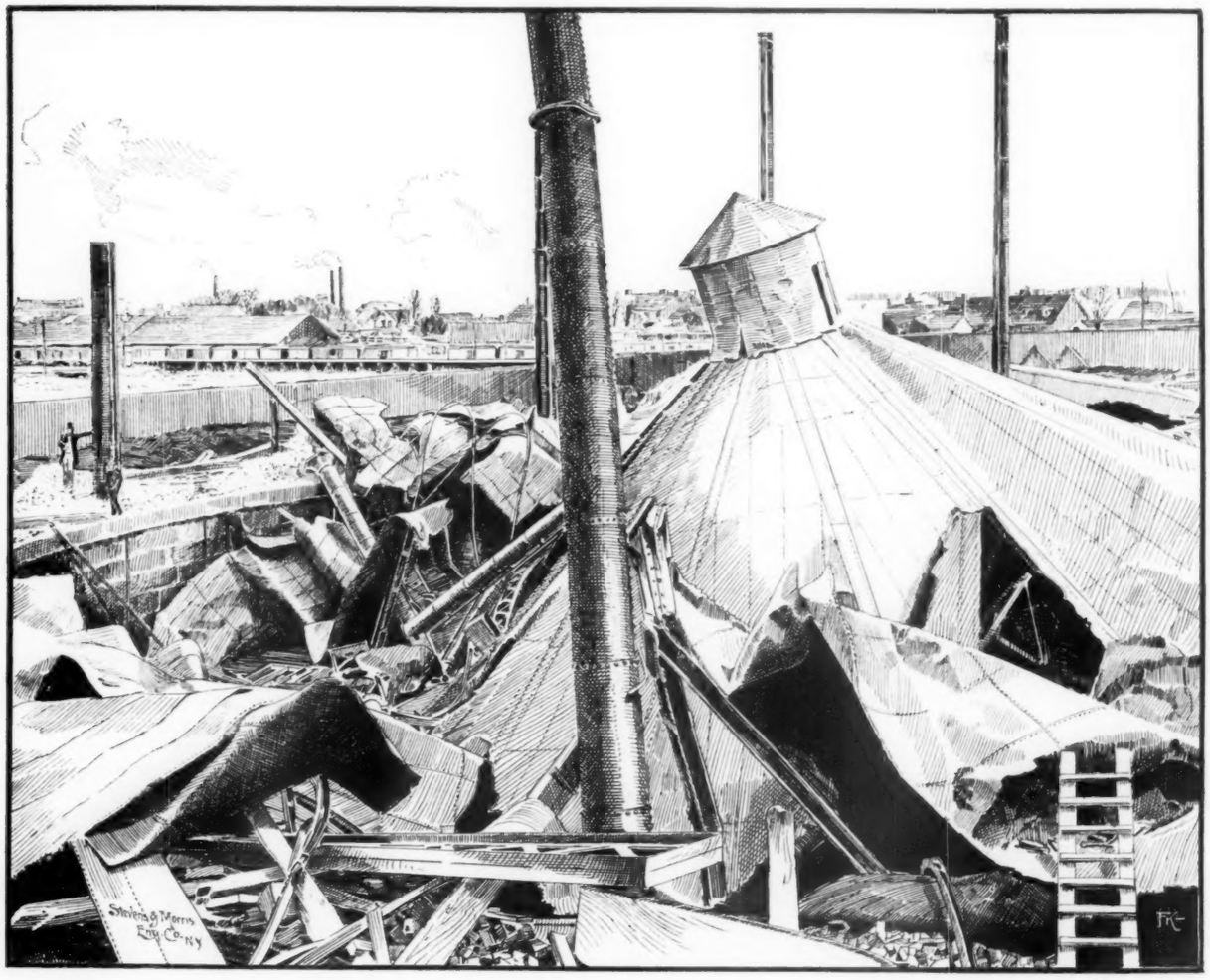
MR. KELLER writes us that he has just sold samples of his adjustable coke crusher (No. 1) to the following parties: W. G. Davis & Bro., Piedmont, W. Va.; the Imperial Coal Company, Pittsburgh, Pa.; and the Great Kanawha Colliery Company, Mt. Carbon, West Va.

The Montreal Disaster.

On these pages will be found two engravings affording vivid pictures of the wreck of the double-lift holder (outside lift 120 ft. 6 in., inner lift 119 ft. 6 in., each lift being 24 ft. 6 in., the entire structure having been inclosed in a 16-sided brick building, covered in by an iron and steel roof) which was about being finished by the Montreal Gas Company for the relief of its Elm street station. For the photographs we are indebted to the courtesy of the Company's Secretary and Manager, Mr. J. F. Scriver.

Our prior account of this deplorable accident, being based on meager despatches, was not intended to be other than an approximation to the facts; but we are herewith enabled, from testimony that is perfectly reliable, to report the case as it happened.

After many months of preparation, arrangements were being made, on May 26, to test the holder, on which date water was turned into the tank. When the water had risen to a height of 10 feet it was discovered that a serious leak existed somewhere in the masonry. The pumps were started in, and, when three feet of water had been drawn off, the weak spot was located—the tank, however, was completely emptied—in one section of the wall; the puddled cone-shaped bottom was found to be perfectly tight. When the defect had been remedied the operation of filling was again commenced, but had not proceeded to any extent before the Company's Engineer, in order to satisfy himself thoroughly as to the solidity of the bottom, ordered a stoppage of the flow, and instructed one of the fitters to remove two of the manhole covers, prior to his (the Engineer's) descent to make the desired investigation. The fitter (a known and tried hand of the Company, who had been in its service for 12 years), for reasons which shall always remain undiscovered, evidently determined to make an inspection on his own account. Having removed only *one* of the manhole covers, he procured a ladder and an *open lantern*, and entered the holder. The terrible result of his fatuous course was the destruction of the inner lift of the vessel, the walls and roof of the structure inclosing it, and the mangling to death of himself and four others, while five of his remaining fellows only escaped death to bear through their lives the scars of many wounds. No gas had as yet been turned into the holder, although all the connections had been made. The inlet valve (20-inch) was perfectly tight, while the outlet (24-in.) leaked slightly; but the pipes were said to be water sealed. Beyond a doubt the fitter and his comrades, including the Engineer, had no fear that gas had escaped into the holder; but such assurance is not to be allowed to go for anything in an attempt to extenuate the act of the unfortunate who with his life—and worse still, that of others—paid the penalty of his rashness. We presume it is not necessary for us to here attempt to give an explanation of how the gas *might* have escaped into the destroyed vessel, for every engineer who reads these lines will form his own theory; and we have an idea that no great difference will exist in the nature of the opinion so formed.

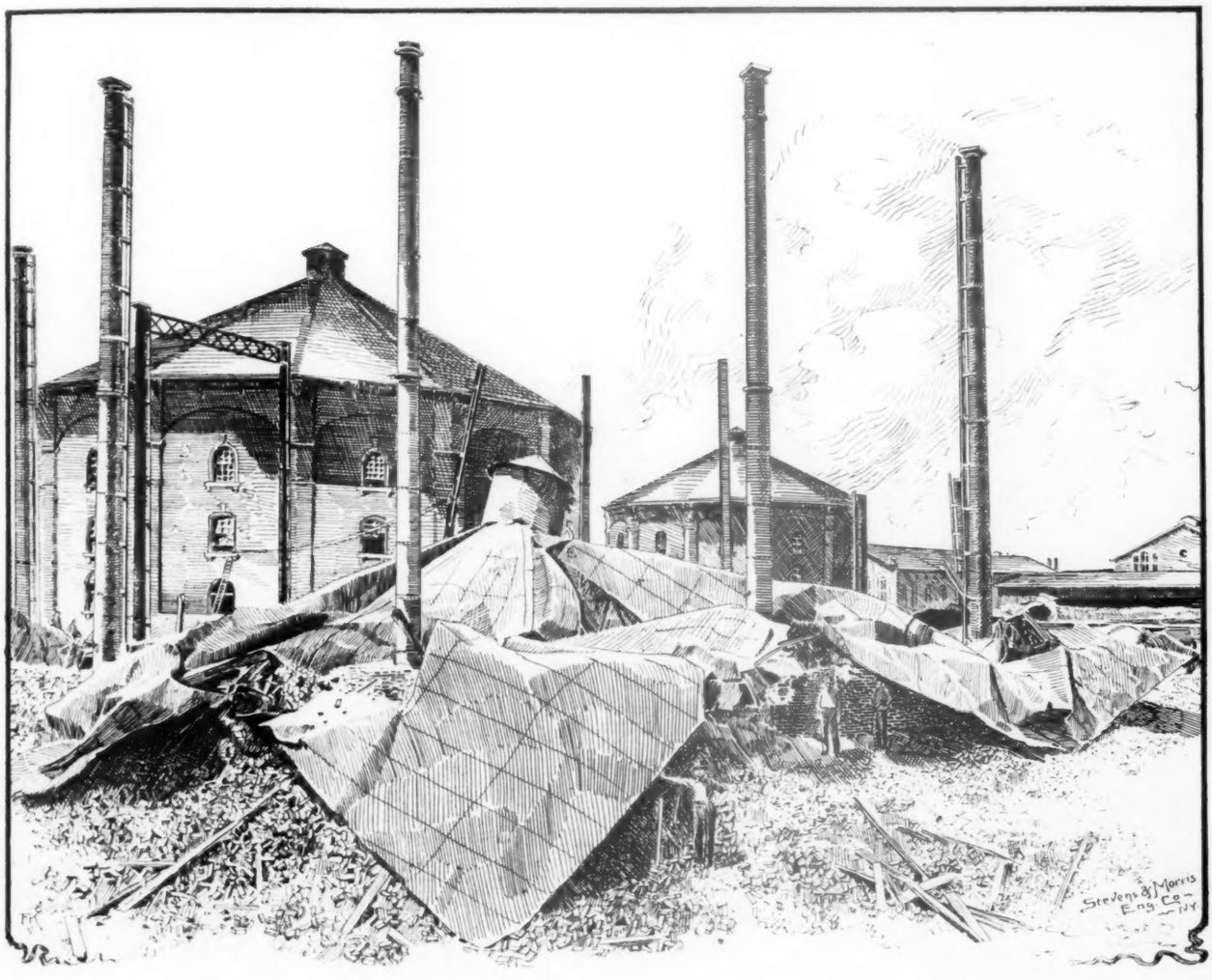


The entire structure, from foundation to roof, stands the Company, in round figures, an expenditure of $80,000; and experts who have since roughly examined the wreck say the net loss to the Company will not exceed 40 per cent. of that sum. The foundation and tank masonry, together with the outer lift, are practically intact, and a considerable portion of the inner lift and roof can be used again. In any event, we may add that, quite in keeping with the energy characteristic of the Company's proprietors, they are already at work on the renewal of the destroyed structure.

The testimony taken at the coroner's inquest seems rather to add to the mystery of the affair than to take from it, that is, in respect to determining how the gas escaped into the holder. The affirmation of R. Colquhoun, who was one of those seriously injured, and whose testimony was taken while he was writhing on his bed, is so graphic that we herewith present a summary of it. He testified that he had been in the employ of the Company for 17 years, and, on the morning of the disas-

ter, was in the second gallery of the holder house, painting some of the heavy timbers in the gallery chambers. A man named Terence Donahue was working close by. He saw Jos. Angell remove the manhole cover, being assisted in the operation by Jno. Angell and S. McAfee. When the cover had been removed Angell ordered McAfee to bring a lantern, and, that duty performed, McAfee and Jno. Angell lugged a ladder to and placed it in the manhole. Angell then tied a cord on the lantern, placed himself on the top rung of the ladder, and dangled the lantern down into the tank. Then, to use Colquhoun's own words: "When I saw him lowering the lantern I put both my hands to my face, for I had been long enough in a gas works to know what to expect. The crash followed instantly, and the next thing that I remembered was finding myself on top of the tank, bricks and iron being heaped up all around me."

Colquhoun's testimony would go to show that he at least of those who were on the premises at the time thought there was gas in the tank.



Indeed his action in "putting both hands to his face" is proof positive of his suspicion.

The jury, after reviewing the evidence, returned the following verdict: "We find that deceased came to their deaths from injuries received as the result of an explosion of a mixture of coal gas and air contained in a gasholder on the grounds and in a building the property of the Montreal New City Gas Company; and that said explosion was caused by the introduction of a lighted lamp into the said gasholder by the late Joseph Angell, an employe of the said Gas Company, and one of the victims of the explosion. We further find that the said Joseph Angell, in introducing the light into the gasholder, acted through ignorance and imprudence, and not from malice or with intent to do hurt or injury."

MR. SHERMAN, the man at the helm of the New Haven (Conn.) Gas Company, has again given the wheel a turn in the right direction. On June 1st the following schedule was proclaimed: The gross rate was reduced from $1.70 to $1.50, subject to the usual discounts of 5, 10 and 15 per cent. according to quantity consumed each quarter.

Calcimine and Its Varied Tints.

The season for renewing interior decorations being now in its height, and believing that a few hints on the method of preparing for and producing varied tints in calcimine will be appreciated, we herewith give some simple rules for attaining the desired end.

To prepare the calcimine base soak one pound of white glue over night; then dissolve it in boiling water, and add twenty pounds of Paris white, diluting with water until the mixture is of the consistency of rich milk. To this mixture any tint can be given that is desired.

Lilac.—Add to the calcimine two parts of Prussian blue and one of vermilion, stirring the mixture thoroughly, and taking care to avoid too high a color.

Brown.—Burnt umber.

Gray.—Raw umber, with a trifling amount of lampblack.

Rose.—Three parts of vermilion and one of red lead, added in very small quantities until a delicate shade is produced.

Lavender.—Make a light blue and tint it slightly with vermilion.

Straw.—Chrome yellow, with a touch of Spanish brown.

Buff.—Two parts of spruce, or Indian yellow, and one part of burnt sienna.

Blue.—A small quantity of Prussian blue will give a soft azure tint. Dark blue is never desirable.

Delicate tints in the foregoing varieties of colors are always agreeable and tasteful, and so great care must be taken that they are not too vivid. The tints will always appear brighter than in the calcimine pot, and the workman or workwoman must keep this fact in mind when adding the coloring powders. It is a good idea to give the ceiling a calcimine two or three shades lighter than that of the walls, so that it may seem merely a delicate reflection of their deeper tones. The ceiling can be calcimined with the lighter tint, and then more coloring added for the walls.

[Official Report.—Concluded from page 391.]

Eleventh Annual Meeting of the Western Gas Association.

Held at Chicago, Ills., May 9, 10, and 11, 1888.

Second Day—Morning Session.—May 10.

Mr. Wm. McDonald, of Albany, N. Y., read the following paper on

THE MAXIMUM SERVICE THAT SHOULD BE REQUIRED FROM THE VARIOUS STANDARD SIZES OF METERS.

Mr. President and Gentlemen of the Western Gas Association:—In presenting for your consideration a paper on an old and somewhat worn subject, I make no apology, but leave the responsibility with your Executive Committee, which did not even say "Will you?" but informed me that I had been selected to read a paper at this meeting, entitled, "The Maximum Service that should be Required from the Various Standard Sizes of Meters."

You will readily understand that there are so many varying conditions involved that I can only give you my opinions, based, as they are, on a number of years' experience in the meter business, and shall expect to be corrected by others who are here, that are just as familiar with the subject as myself, if I do not draw my lines from well established points.

Just how much ground the Committee intended should be covered when they named the paper I could not fully determine, but concluded that, as they had named the paper to suit themselves, I was entitled to the privilege of writing it to suit myself. I have therefore divided the subject into three parts—namely, Capacity, Durability, and Accuracy; and shall treat them in the order named.

Here let me say that while some things I shall say will apply to wet meters, I wish to be understood as referring more particularly to dry.

What is the capacity of a 3-light meter, of a 10-light meter, of a 100-light meter? How many burners will a 60-light supply?

We have a church with 120 burners; how large a meter will be required?

These and many other questions of a similar character are constantly being asked by those who have been, and are now, supplying illuminating gas.

Now comes the fuel gas and the natural gas man, and he wants to know in addition how heavy a pressure the meter will stand, or how many fires he can register with a 100-light or some other size.

These and some others are the questions I am going to try to answer.

The meter does not care how many burners there are, nor how many fires are burning, and but comparatively little what the gravity of the gas is. What it does care for is the speed at which it is to be worked and the quality and temperature of the material it is asked to measure.

The rapidity of its movement depends entirely upon the quantity of gas that is passing through it. (This is often questioned, but is strictly true.) If the 120 burners mentioned burn 2 feet each per hour, 240 feet per hour is being consumed, and a 30-light meter would easily do the work. If instead these were 6-feet burners, that would mean 720 feet per hour, and an 80-light would be required.

I have tried to formulate a rule for maximum speed or capacity. Here it is:

Multiply the number of lights the meter is called by *ten*, for the number of feet per hour, and you have the maximum capacity of the meter.

Take, for example, a 100-light meter. Multiplying 100 by 10 gives 1,000 feet per hour as its maximum capacity.

With meters made as at present, this would give the following rates of speed:

3-light	.....	240	revolutions per hour.
5 "	.....	300	" "
10 "	.....	400	" "
20 "	.....	400	" "
30 "	.....	360	" "
45 "	.....	360	" "
60 "	.....	360	" "
80 "	.....	350	" "
100 "	.....	350	" "

You will notice that this rule gives the 3 and 5-lights proportionately very much less to do than the other sizes, and the rule does not so strictly apply to these as to the larger ones. Owing also to the works being lighter and the distances traveled shorter, they will bear considerable increase from this amount. When I speak of a revolution I mean one entire movement of the works of the meter to the starting point.

I think that dry meters will very comfortably stand one pound pressure to the square inch if the rate at which they are run is carefully controlled.

Durability.—How long will a meter last, or how long should it last, are questions often asked. I contend that this depends almost entirely upon how it is used. If you were to run them at the rate I have given you as a maximum, and kept them going 24 hours per day, I should expect some would begin to feel tired at the end of the first year.

You may think this is using a meter up pretty quick; but let me tell you what amount of work the different sizes up to 100-light would have done in one year at this rate:

3-light,	2,102,400	revolutions....	measuring	262,800	cu. ft.
5 "	2,628,000	"	"	438,000	"
10 "	3,504,000	"	"	876,000	"
20 "	3,504,000	"	"	1,752,000	"
30 "	3,163,000	"	"	2,628,000	"
45 "	3,153,000	"	"	3,942,000	"
60 "	3,153,000	"	"	5,256,000	"
80 "	3,066,000	"	"	7,008,000	"
100 "	3,066,000	"	"	8,760,000	"

This, at the present price of meters, would give slightly under 1 cent per thousand as the cost of measurement.

To most of you these will seem like large figures, and you will be ready to say, "If we could get this much out of our meters we would be more than satisfied." This is what I believe the meters are capable of doing if subjected to no other deteriorating influences than actual wear. It will hardly be necessary for me to carry out for you the length of time a meter would last if run less hours per day or at a less rate of speed than those given, as each of you can figure that as circumstances seem to require, keeping always in mind that any machine worked up to its greatest possible capacity will give out proportionately sooner than if more moderately used.

Accuracy.—It has been said that fools press in where angels fear to tread. I may be exemplifying the truth of this saying, but I shall be careful where I step. Accuracy is really of more importance to the seller of gas than either of the other points mentioned; and the question is often asked, "Are meters accurate?" I unhesitatingly say, yes, if given a *fair* chance to be so.

Meters, especially dry ones, have three things to contend against that cause them innumerable troubles. Impurity, condensation and temperature; and the greatest of these is temperature. Given a gas that does not carry with it vapors that condense, that is free from sulphurous or acid compounds, and that is kept at a moderate and uniform temperature, and almost absolute accuracy of measurement can be secured.

That these conditions do not always prevail is certain, and that it is almost impossible to entirely control them is equally true; but I do believe that if in the manufacture of gas, in the laying of mains and services, and the placing of meters, these things were more carefully considered, greater durability and accuracy would be secured. When the time does come when the gas manufacturer shall deliver perfect gas, through perfectly-laid mains and service pipes, and meters are placed in perfect places, then, and then only, will the various standard sizes of meters perform that *maximum* service that the laws of nature and the meter manufacturer intended they should.

Discussion.

Mr. Odiorne—Where is the best place in a building to put a meter; and what ought to be the temperature?

Mr. McDonald—I think that the cellar is the best place, and that the temperature of the location should not be below 50° nor above 70°.

Mr. Dunlap—Suppose the temperature of your gas when it leaves the holder is about 40°. What would you do in that event?

Mr. McDonald—It is to be presumed the gas will remain at about that temperature, provided the pipes are buried deep enough to remain unaffected by frost. In fact, were your pipes below the frost line, I think the gas would in its travel through them be brought up to 45° or 50° before it reached the meter.

Mr. Woodmansee—What is the detrimental effect of cold upon a meter?

Mr. McDonald—If a meter is extremely cold it is liable to stiffen up some, and thus will work harder.

Mr. Odiorne—Does the use of alcohol for thawing out a meter have any injurious effect on it?

Mr. McDonald—I think not, provided, of course, that the alcohol is properly applied.

Mr. Ransom—I would like to ask what is the effect (with regard to accuracy) when a meter runs at a greater speed than it should?

Mr. McDonald—My idea is that in such cases the accuracy of the meter would be but slightly affected. If the rate of speed were great enough to injure some portion of the mechanism, then either the meter would fail to pass the gas, or else the gas would go through without being measured.

Mr. Ransom—Would the overworked but sound meter register correctly the quantity of gas used?

Mr. McDonald—Practically so.

Mr. Thompson—What has been your experience with meters used to measure water gas, and *vice versa*? How does water gas affect a meter?

Mr. McDonald—That is a hard question to answer properly; but my experience is that a well-made water gas does not affect a meter very much more seriously than does coal gas, save possibly in this way. When a meter that has been measuring water gas is taken out and allowed to stand for awhile, the diaphragm will almost always harden; therefore such meters ought to be looked after before being connected again. There is a very great difference in water gas. I have seen some meters that were nearly destroyed by water gas.

Mr. Thompson—Has it not a tendency to make the meter fast?

Mr. McDonald—Anything which causes the diaphragm to harden will lead to fast registration.

Mr. Page—Will Mr. McDonald explain his statement that well-made water gas does not affect a meter differently from coal gas?

Mr. McDonald—I did not say so. I said I did not think it did very much more—if carefully made; but there is no question if a meter which has been working on water gas is removed and allowed to stand idle for awhile, its diaphragm will harden more easily than if the same meter had been measuring coal gas.

Mr. Page—Do you understand the reason why the diaphragm will harden more rapidly?

Mr. McDonald—I presume it is owing to the differing nature of the components of the gases.

Mr. Page—Would it be owing to the ease with which naphtha is separated from the combination?

Mr. McDonald—If naphtha is separated, that, of course, would harden the diaphragm.

Mr. Page—What effect would free hydrogen gas have upon the diaphragm?

Mr. McDonald—I do not know.

Mr. Page—Possibly some other meter manufacturer will answer that question; and also state what effect carbonic acid has upon a meter diaphragm?

Mr. McDonald—I cannot say, with certainty.

Mr. Page—Is it your opinion that the injurious effect is chiefly produced by the naphtha separated from the combined gas?

Mr. McDonald—I have not had that opinion.

Mr. Jenkins here read an extract from the morning issue of the Chicago *Times*—as he thought it might be admitted under the head of the meter discussion. The extract bore the heading, "Gas is cheap in Chicago, because a magnate says so," and the scribe went on to say:

"Gas is cheap in Chicago. It is a popular error to suppose that it is high priced. The Western Gas Association, or its Secretary, Mr. A. W. Littleton, of Quincy, says it is cheap. On the principle of the mind cure or mental science all that is necessary is that the people of this city should believe that gas is cheap, and should concentrate their minds on that idea, and gas will be cheap. It is not the gas that is expensive. The bad men who are to blame are the coal barons.

"'The price of gas,' says Mr. Littleton, 'depends on the amount manufactured, and what the manufacturers have to pay for their coal.'

"Here is the solution of the gas meter problem.

"'The price depends upon the amount manufactured.' The more gas is manufactured the cheaper it will be. It is from a purely humane motive that the gas companies push so much gas through the meters. By manufacturing so much more they make gas so much cheaper. 'In Chicago,' says Mr. Littleton, 'they may make gas at $1.50 and make lots of money, whereas in Quincy they couldn't afford to.' Chicago, St. Louis, Indianapolis, Louisville and Milwaukee have cheap gas, the same authority says. In most other cities west of the Alleghenies prices range from $1.50 to $2.50. If gas companies make 8 per cent. profit they are doing well."

Mr. King—As the newspaper man's "Magnate" is a representative man in this Association, I think we would all be interested in hearing further from him on this subject.

The Secretary—The "Magnate" has no remarks to make about it.

On motion of Mr. Canby, a vote of thanks was passed to Mr. McDonald.

Amending the Action which Named Indianapolis, Ind., as the Place wherein to Hold the next Meeting.

Mr. Howard now moved that the vote which ratified the report of the Committee on naming place of next meeting be reconsidered. Mr. Jenkins (of the Committee) deprecated any such action. He said that no objection had been made before the Committee to the only place which had been presented to them during their session. Indianapolis should be and was named on two grounds, one of which was that its turn had been reached, according to the sentiment expressed here a year ago that a circuit of 4 or 5 cities be established; the second reason being that Past President Somerville desired the Association to visit Indianapolis. He thought, in justice to the Committee, the original action should stand, although in making this statement he did not wish to convey the impression that the Committee desired to prejudice the best interests of the Association in any way. Mr. Howard disclaimed any intention to be discourteous to the Committee. His motion was made because much complaint had been indulged in by members who were not present when the Committee's report was presented and ratified. Mr. Lansden thought that Indianapolis ought to remain the choice of the Association. They owed it to themselves and to their Past President to assemble there next year. Mr. Howard hoped the modesty of those who wished to visit Cincinnati next year would not prevent them from being outspoken, now that the subject was under discussion. [The motion to reconsider prevailed.] Mr. King then moved that Cincinnati be substituted for Indianapolis in the report of the Committee. In discussing this substitution Mr. Lansden opposed the suggestion, as also did Messrs. Starr and Moran. Mr. Odiorne said the objection to Indianapolis was because of its limited hotel capacity, and its comparatively small size as well. He thought the members liked to go to a big city. The President thereupon suggested that as Chicago was larger than either Indianapolis or Cincinnati, perhaps many of the delegates would not mind visiting Chicago next year, even though the present session was being held in that city. [The motion to substitute Cincinnati for Indianapolis was carried by a vote of 44 to 26].

Mr. Henry Pratt, of Chicago, Ills., read his paper on—

INCLINED RETORTS.

Gentlemen—The subject of inclined retorts having been assigned to me, I wish to state that I cannot give you much new light on an old subject, for it dates back to 1804 and 1805, when William Murdoch employed an iron pipe or retort, placed at an angle of about 45°, with a lid on both ends. (*King's Treatise*, page 163.) No detailed account of it, however, is given.

Next, John Grafton obtained a patent in England for inclined retorts, December 10th, 1818. He employed iron retorts lined with fire clay, which, in his specifications, he says that he "placed in an inclined position for the convenience of discharging the contents." He also employed a secondary retort, with feeding apparatus, to receive the tar separated from the gas, produced by the first retort, and to introduce the tar into the secondary retort in order to be redistilled into gas. Grafton's idea of redistilling the tar at that time deserved more consideration than we would be willing to give it at the present time; but, to study their mode of gas making, the only conclusion we can arrive at, with the low heats that were used to distill the coal, is that there must have been much light oil in the tar, which, with high heats and naphthaline, to-day does not exist. Practically, to John Grafton belongs the credit of the first inclined as well as the first clay retorts.

Again, in England, John Brunton obtained a patent, October 2d, 1828, for a conical-shaped retort set in a vertical position with the large end downward; but Brunton, it appears, changed this plan of setting his retort, for, on March 25th, 1835, he was granted a patent for a charging and discharging device. He retained the conical shape of his retort, but placed it horizontally—or, the top was level, leaving the bottom on an incline; the coal was put into a hopper, which was then closed, and a slide was drawn and the coal deposited in the end of the retort, in front of a piston which was worked by a screw, and forced the coal and coke that was in the retort forward toward the discharging end, where the coke would drop down through the discharge pipe into the water equivalent to the coal put in, as he says in his specifications, "without exposing the interior of the retort to the cooling effects of atmospheric air, and in a great measure avoiding the loss of time, the waste of gas, and the laborious operations necessarily attendant on the usual methods of charging and discharging retorts." Unless Murdoch's grappler would be called a machine, John Brunton was the first to introduce charging and discharging apparatus, or mechanical stoking.

Mr. Brunton claims that there was a saving of 30 per cent. in labor and tools, and 35 per cent. more gas made from the same amount of coal.

Again, May 27th, 1851, Alfred Vincent Newton was granted a patent in England (which was communicated from abroad) on an improvement in the carbonization of coal, etc.; and in the specification he says, "For this purpose, the retort is placed in such a curved and slanting position that when the lower mouth of the retort is opened at the termination of

a charge the hot coke will slide down into a cooling chamber placed also in a slanting position. The charge of coal may be renewed at the upper end of the retort, where a tilt wagon and rails are provided for that purpose."

September 20th, 1881, in the United States, Frederic Egner was granted a patent for an inclined rotating retort, but owing to its construction being peculiar to itself, it would not properly come under the title of this paper.

Several devices have been invented and patented to charge inclined retorts, which I will not take the time to point out in detail; but the one that appeared to me to be the most practical, was a system invented by Andre Coze, Director of the Gas Company of Rheims, France, and patented in England by Alexander M. Clark, June 20th, 1885. A part of the first claim is in a "bench of retorts for the distillation of coal and other solid matter, the combination of inclined retorts with bent charging mouths forming prolongations thereof."

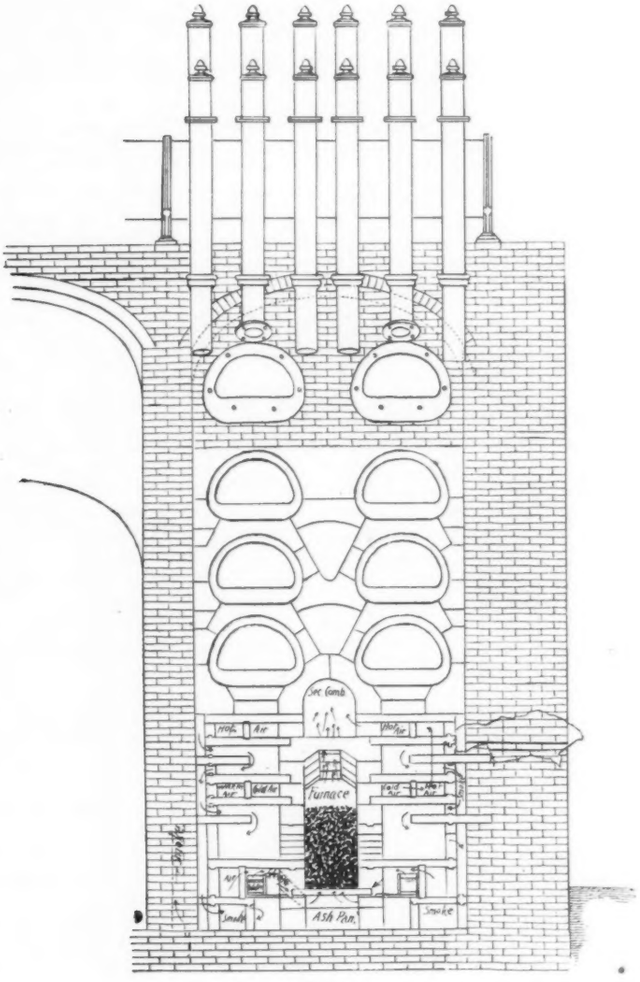


Fig. 1.

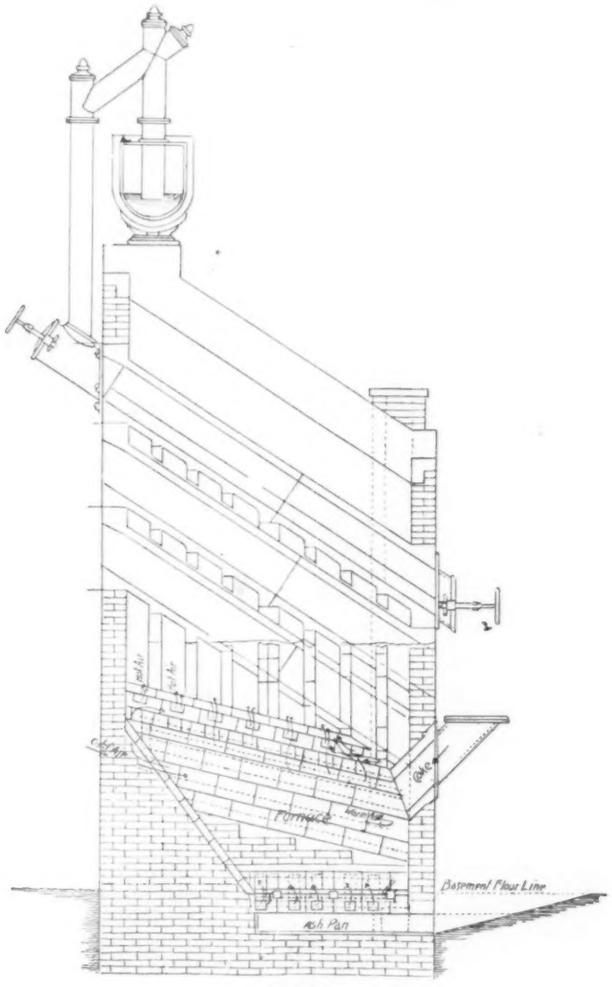


Fig. 2.

I will say that the mouths are bent upward, and terminate at the level of the top of the stack or charging floor with a cover or lid. The stand pipes are shown to be attached to either end, but to put the stand pipe at the lower end would be wrong and quite the reverse from what it should be, as the largest per cent. of coal is carbonized in the lower half of the retort, and as a portion of the vapor which is driven from the coal would not have to pass through sufficient heat to make it into a fixed gas, it would again condense either in the mouthpiece or farther along in the works. On the other hand, by placing the stand pipe at the upper end, all vapor has to pass through the retort for a greater distance than it would by placing the stand pipe at the lower end; or, to put it in another way, it would be the same as charging an ordinary horizontal retort, and leaving the coal piled near the mouthpiece.

After a period of nearly 100 years, with the recorded experiences of so many eminent gas engineers, it would seem that there was but little to hope for in the way of improvement, to economize in the manufacture of coal gas; yet when we look upon the continued change and improvements that take place in the different arts and manufactures, we cannot believe that such a state of perfection has been reached that improvement is impossible. Taking the latter view and with natural gas, carburetted water gas and other gases, together with electric light, taking the place of coal gas, we ask; why is it thus? Can we by any means improve in the process of manufacture, so that we can cheapen the cost of coal gas? It was this incentive that caused me to try inclined retorts.

In the year 1885 the Company I was with was contemplating the erection of a large retort house and everything connected therewith, to be of the most approved construction—it was afterward, however, decided to make only water gas. I made drawings (see Figs. 1 and 2) for a system of inclined retorts with a charging apparatus therefor, and to do the work of charging and discharging the retorts with the elevator and by gravitation. I constructed one bench of sixes. The retorts were 13 by 24 inches at the upper end, and 13 by 28 inches at the lower end, by 12 feet long, and in two pieces, and were made by the Chicago Retort and Fire Brick Company. The retorts were set at an angle of about 30°. This bench was fired only with a common furnace, and, being isolated, the heat was not as high as desired. It was used for about 6 weeks. At the lower end of the retort we used a stop to prevent the coal from getting down to the lower lid—the stop was placed about 9 inches inside of the front wall in the retort, so that the charge should be held where the retort was sufficiently hot to carbonize the coal. The bench being built only for trial, I did not have any charging machinery; and it was sometimes charged by dumping the coal into the retort, and at other times with a scoop shovel. The charging was equally well done by dumping as shoveling. The charge was usually even in the

retort, except slightly piled against the stop at the lower end. At first I had some fear as to this part being burned off as soon as the remainder of the charge, and to guard against this anticipated trouble, I put two or three shovels of coke into the retort. At first, the coke would slide down to the stop and take the place of coal. In this way the charge was practically even, but when I left the coke out, I found that I had attached too much importance to this inequality, and had not theorized correctly, as the charge usually burned off as near even as could be desired. I sought for a reasonable explanation, and concluded that that part of the retort had but little (if any) more work to do to carbonize the coal that naturally went there, than any other part, as the heat was communicated direct to the coal at that point, while farther up the retort the heat would be used to fix the vapors that were driven off from the coal below, and be carried off in the gas and deprive the upper part of the retort of that heat energy which is exerted near the lower end.

I tried charges of from 100 to 500 pounds per retort, and found but little difference in the working, whether the charge was light or heavy.

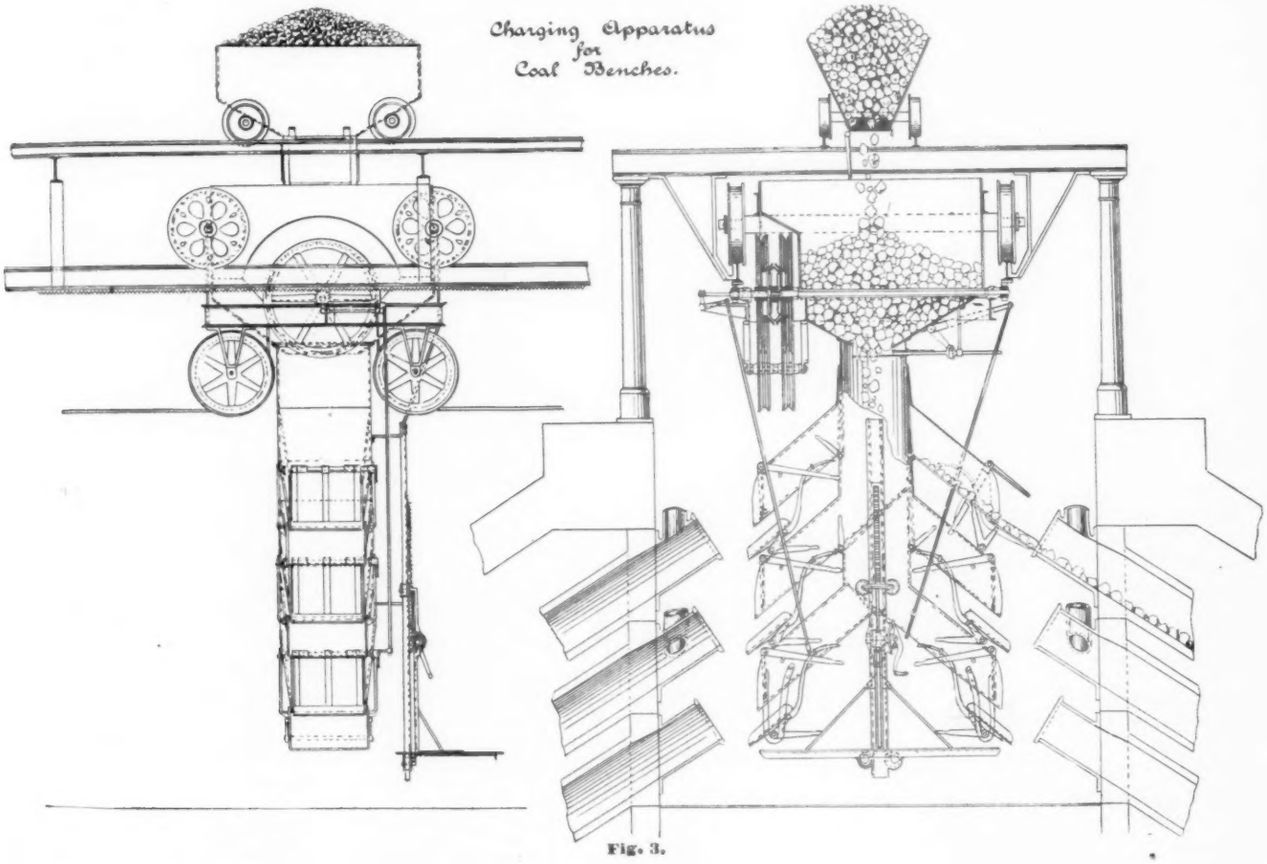


Fig. 3.

A charge that was well burned off would usually discharge itself as soon as the stop was removed without the assistance of the workman; but when a charge was not burned, it would sometimes require the assistance of the stoker, aided not with a rake, but with a three-quarter-inch rod. In cleaning the retorts, the lower lid was slightly opened, to allow only sufficient air to pass up through the retort to burn the carbon, and not cool the interior with an excess of air; the upper lid could remain full open.

The charging apparatus (see Fig. 3) that I designed, was a traveling hopper with a square spout, or conductor, extending downward to the bottom of the lower retorts and delivering the coal right or left to both stacks. At the height of each retort was a chute, with a stop to turn back, to stop the coal for each separate retort. This traveling hopper and the chutes were designed to be hung on the under side of iron beams, which would extend across from one stack to the other, and be propelled by an endless wire rope, passing over loose pulleys on the hopper and operated by friction. On top of the beams is the track from the coal shed and elevator. From this track the coal cars could dump their contents into the hopper wherever it was standing.

In a coal gas works with a daily send out of 200,000 cubic feet and upwards, such a system, properly constructed, I think could be used with a large saving to a company in labor account, as well as saving much time in charging and discharging, and also in cleaning retorts; but unless such a system was properly constructed, it might prove not only to be very unprofitable, but also a costly experiment. In small works, where division of labor is impossible, and with the cost of construction largely augmented, I do not believe that inclined retorts could be used with much profit. The bench was used in connection with the rest of the works at that time, and I could not make any comparative tests of the yield, candle power, etc., but intended to do so subsequently, as I desired to make a slight alteration in the furnace and flues, that I might be able to work with a higher heat.

As I before stated, the Company decided to make only water gas, and having so much other work while I remained with the Company, I was unable to make another test. I did not construct the bench for technical experiments, but as far as possible to satisfy myself as to the practicability of such a system before I would recommend the expenditure of so much capital with a possibility of it resulting in a failure; therefore, the bench was built only to find its defects, that they might be remedied, should it be built for practical purposes.

I did not expect to be asked to write a paper on the subject at that time, or I should have kept the minutes differently, and made a proper test.

In conclusion, I will say that in ordinary bench settings I do not set the retorts level, except possibly the lower retort. I prefer to set the back end of the middle retorts from 1½ to 3 inches, and the top retorts from 3 to 5 inches higher than the front end, according to the height of the retorts, as it makes the work much easier for the stoker where the work is done by hand, and, therefore, affords a possible chance of saving time.

Discussion.

Mr. Walsh—In connection with Mr. Pratt's remarks I may say that about a year ago I visited Rheims, and met Mr. Coze, who had a bench of 9's on the inclined plan in operation at the Rheims gas works. His first experiments were made with a single retort, then with a bench of 3's, and subsequently with a bench of 9's, which he connected with a bench of 6's, operating them with a Siemens regenerative furnace. Having seen the system in operation, and being very much pleased with it, I arranged with Mr. Coze to have a similar bench installed at our

works in St. Louis, which bench has now been working there for some 9 or 10 days. It took considerable time to get everything in readiness, because, in the first place, the retorts, and all the castings as well, were shipped from France. Although the results thus far have been perfectly satisfactory, yet, being an isolated attempt, we expect to improve these as our knowledge of the system becomes perfected. Our Superintendent, Mr. Taylor, will probably answer any questions that may be asked with regard to the actual operation of the bench. I have with me a full set of plans (drawn only as French engineers can draw, for they excel in such things), for 3, 5, 9, or 10 retorts, an inspection of which may prove of interest to the gentlemen present. I shall be most happy to exhibit the drawings.

Mr. Murdock—I would like to ask Mr. Taylor if he obtains better results from the inclined bench than those usually obtained by us who work under the ordinary plan.

Mr. Taylor—This bench had been operated 7 days prior to my having left home, but I can give you the results of a 24 hours' run. One bench 5's, on the Coze inclined system, as operated in the St. Louis gas works, in 24 hours, carbonized 9,600 pounds Youghiogheny coal, which yielded 48,864 cubic feet of 16 to 20-candle gas, or 5.09 feet per pound. The coke produced was 157 bushels (35 pounds per bushel), of which quantity 74 bushels (about 47 per cent.) were burned in the furnace. As this bench is set in a frame shed, entirely isolated from the general retort house, much better results would be obtained did the Coze setting form a member of a regular stack. We charged in that bench 400 pounds to each retort. The proper heat has not yet been obtained. I think the retorts will bear 500 pounds.

Mr. Woodmansee—How large are the retorts?

Mr. Taylor—They are about 11 feet long, with 15 by 26 inch mouthpieces.

Mr. Dunbar—How long did the charges remain?

Mr. Taylor—For 5 hours.

Mr. Dunbar—Do you want them to remain in 5 hours?

Mr. Taylor—Until we get the proper heat.

Mr. Clark—You used different qualities of coal?

Mr. Taylor—Not different qualities, but different sizes. I find that egg coal spreads best in the retorts.

Mr. Lansden—Does not Mr. Taylor find the greatest benefit, as far as his experience has gone, to be gained from the saving in labor?

Mr. Taylor—There is a saving in labor, and a further gain in the increased quantity of gas. There is less leakage, also. It does not take two seconds to put in a charge and close the lid. In addition to all this, the removal of the plug from an inch aperture in the top mouthpiece enables us to burn out all the carbon that has been deposited on the walls.

Mr. Pratt—Speaking of the different qualities and sizes of coal used, I may state that we find the momentum with which we put the coal into the retort governs the way the charge went in. Even the slack coal had to go in with a little more force. I designed a chute which would either hold the coal back or allow it to go in with force, according to the quality of the coal used.

On motion of Mr. Lansden, a vote of thanks was tendered to Mr. Pratt.

Mr. Edward Lindsley, of Cleveland, Ohio, read his paper on

INCANDESCENT GAS BURNERS.

Mr. President and Gentlemen:—The appointment of a Committee to select subjects to be presented at our meetings, and assign them to individuals for presentation is, doubtless, a move in the right direction, tending to insure a sufficient number of papers, as well as care in their preparation, while the preliminary announcement will tend to insure a hearty discussion—which is often the most valuable thing connected with a paper—and I wish I could compliment the judgment of the Committee in their assignment of the subject of Incandescent Gas Burners.

In the latter part of February I was notified that I had been elected as a victim for this meeting, and would be kindly permitted to select my own subject, provided I chose to write about incandescent gas burners. I meekly acquiesced, and immediately corresponded with a number of parties, either interested in or inventors of such devices, hoping thus to gather facts, data, or materials from which to make this paper both interesting and profitable; but one "had bought some land," another, "five yoke of oxen," while a third had "taken unto himself a wife;" or, to put it a little differently, nearly all were experimenting and not ready to communicate; and so it happened that but one of the entire number accepted the invitation and "came to see me."

Up to this time, what we understand as incandescent gas burners have not been scattered broadcast throughout the land. Indeed, there may be some present who never saw one, save possibly the improvised affair of the blacksmith, who heats to whiteness a rod of iron to aid in his scrutiny of a dark corner at the close of a short winter's day.

My own direct knowledge of them is a very meager quantity. What I do not know is a more voluminous matter, and might easily be written into a very large book.

Probably most present have a fair idea of the characteristics as to materials, mode of construction and form, together with the photometric capabilties of the more prominent types of incandescent burners. Bright men of opportunities, such as Messrs. James Dredge, Editor of *Engineering*, Geo. Graeff, Jr., C. W. Lungren, of regenerative lamp fame, and many others, have written so exhaustingly on the subject of incandescent gas lighting, and treated it so largely as a question of burners, that there really seems little room to say more about them and avoid a suspicion of plagiarism. Therefore I trust new and startling revelations will not be expected here. Indeed, if I may present a few thoughts that shall serve as a lever to move the spirit of discussion it will be as much as I hope to do. In referring to my correspondence I used the word "experimenting," because some of our incandescent friends used it, or its equivalent in communicating with me. I would not thereby convey the impression that I think lightly of what has actually been accomplished by many of them: for whether we consider the Welsbach mantle, as recently improved, the magnesia basket of Clamond, the platinum cone of Lewis, or the modifications by Sellon, or the magic comb of Fahnehjelm, or the somewhat analagous arrangements of Lungren or Stewart, or other meritorious forms too numerous to mention, we cannot withhold our admiration of the beautiful effects produced, nor put away the thought that wonderful possibilities may lie beyond. Of course, it is the commercial aspect of this question that chiefly interests us here; and that may not be well considered without taking into account the gas used as well as the burners using it. Therefore, will the Association and Committee of Assignment kindly indulge me if I depart slightly from a literal consideration of the topic given me.

Not long since the commercial idea of gas included little else than the product obtained by the distillation of bituminous coal—used, first, as a luxury, and afterwards as a necessity, for illuminating purposes chiefly. Then water gas sprang into commercial being, and, quickly assuming aggressive and progressive proportions, at times seemed to threaten arrested development of the old standby, the two often contending side by side for public favor. This competition, with an added element furnished by electricity, stimulated effort to furnish gas for fuel and power purposes, which was so far successful that the public gained an idea of the possibilities of gaseous fuel, and were demanding it, with more or less earnestness, when natural gas came to the rescue, in certain favored sections, since which the desire for fuel gas has become almost if not quite a universal craze.

Uncarburetted water gas was thought by some to be a solution of the problem, and attempts were made to work it out on that basis—in connection with which it was sought to resolve heat units into units of light, and so incandescent burners came—at least such is near enough the truth for our present purpose. As my acquaintance with or personal knowledge of them pertain more particularly to two types, which differ very decidedly in construction and action, but probably represent as fairly as any the commercial practice of the day, I trust that, as I shall have occasion to refer to them, I may not be charged with invidious comparison if I use two, viz.—the Welsbach and Fahnehjelm—for such reference. A brief description of each may not be out of place here.

The latter is not unlike an ordinary coarse comb with the back curved, in the direction of its length, toward the teeth. The back is a grooved piece of metal, in length corresponding very nearly to the width of the heating flame, which is produced by the gas from an ordinary flat-flame burner.

The teeth are small rods of magnesia, say, 2 inches long and about No. 18 wire gauge in diameter. Double rows of these are secured to the metallic back, by a suitable cement, within the above-mentioned groove, and this simple device is supported over the gas flame. The result is a very white and beautiful light. Of its photometric value I cannot speak with authority; but, judging from its color, should expect it to be deceptive to the eye—not unlike the electric arc, brilliantly dazzling, but lacking diffusive power. Less than a year ago Mr. Dredge gave the cost of a comb, complete, as five cents, and put the life of the magnesium pencils at from 80 to 100 hours each.

They are unsuited to rough handling, and, doubtless, most disinterested people would regard them with suspicion on account of their frailty. They are particularly adapted to the action of the uncarburetted water gas flame; although good results may be obtained with the Bunsen flame of common coal gas, or the same gas largely diluted with common air.

For a description of the Welsbach I quote Mr. Dredge, who says, sub-

stantially: "A hood of fine fabric, such as net, is impregnated with zirconium solution, and, when dried and shaped symmetrically, is suspended by platinum wires over a Bunsen burner; the whole being preferably inclosed within a glass chimney. When the burner is lighted the combustible portion of the hood is rapidly burned, and the water of the solution evaporated, leaving a skeleton of zirconium oxide, a perfect replica of the original fabric. Under the action of the heat this delicate surface is brought up to a vivid incandescence." Since this description was given the mantles have been made in this country, and, there is reason to believe, very materially improved. The first samples the writer saw were imported, and certainly very frail and delicate to the touch; but, if memory serves, even these were claimed to be capable of living from 500 to 600 hours' use, and the kind of gas a matter of comparative indifference. Indeed, from personal observation, I can say the burner showed good results with either coal or natural gas—apparently the best with natural gas, as I now remember. But actual test is more to the point; and, through the courtesy of Mr. A. C. Humphreys, of the Welsbach Incandescent Gas Light Company, am able to present reliable figures. They were prepared by our President, Mr. Emerson McMillin. The entire report would, in itself, constitute an interesting paper; but would make this one too voluminous. I therefore draw upon it for the cold facts. On March 15th the following record was made, the gas being measured through a photometric meter, and the candle carefully weighed:

Burners, Nos.	1.	2.	3.	4.	5.	6.
Candles.....	29	23	13	28	34	32

Gas used in each case, 2.9 ft. per hour; pressure, 0.89 inch; previous to test the burners had been used about 20 hours. It may be observed that No. 3 burner gave but 13 candles, but as it was of the variety which yield a white light, it was selected as the best by a number of observers, thus demonstrating how easily the eye may be mistaken.

The burners in above test gave candle power per foot of gas as follows:

Burners, Nos.	1.	2.	3.	4.	5.	6.
Candles.....	10	8	4.5	9.7	11.7	11

For the next 10 days these burners were used intermittently, 6 to 9 hours per day, and afterwards to and including April 14th, constantly; making a total service of about 600 hours.

The next test in the record, made March 19th, and using 3 feet of gas per hour, after about 50 hours of actual use in a period of 140 hours, gave the following results:

Burners. Nos.	1.	2.	3.	4.	5.	6.
Candles.....	26	18	10	20	24	26
Candle power per foot..	8.7	6	3.3	6.7	8	8.7

On the 27th, after 160 hours' use, the same burners, using 3.3 feet of gas per hour, were tested against a Sugg gas burner, using 5 feet per hour, with the following results:

Burners, Nos.	1.	2.	3.	4.	5.	6.
Candles.....	25	19	6.1	24	24	27
Candle power per foot.....	7.6	5.75	1.8	7.3	7.3	8.2

On March 31st, after 254 hours' use, against a gas burner as in last test, using 3.2 feet of gas, they tested as follows:

Burners, Nos.	1.	2.	3.	4.	5.	6.
Candles.....	19	15	6	21.6	19	21.6
Candle power per foot ..	6	4.7	1.87	6.75	6	6.75

On April 6th, after 400 hours' use, tested with 3 feet per hour, and against a gas flame:

Burners, Nos.	1.	2.	3.	4.	5.	6.
Candles.....	18	9	6	19	14	18
Candle power per foot.....	6	3.3	2	5.7	3	6

On April 14th, under same conditions as the last, after 600 hours' use, the tests gave the following results:

Burners, Nos.	1.	2.	3.	4.	5.	6.
Candles.....	18	10	6	17	9	18
Candle power per foot.....	6	3.3	2	5.7	3	6

In these later tests I assume the pressure was the same as in the first; and, you will observe, were against a gas flame.

The next and last test was made with great care, against a candle carefully weighed, and burning 120 grains per hour—the burners using 3 feet of 20-candle gas per hour—with the following results:

Burners, Nos.	1.	2.	3.	4.	5.	6.
Candles.....	18	15.4	7	17	15	21
Candle power per foot.....	6	5.1	2.3	5.7	5	7
Corrected for temperature and pressure.....	19.3	16.4	7.5	18.2	16.1	22.5
Candle power per foot.....	6.4	5.5	2.5	6.1	5.7	7.5
For 5 feet of gas.....	32.2	25.7	12.5	30.3	27.5	37.5

From the foregoing it appears that the per cent. of depreciation, after 600 hours' actual use, is as follows:

Burners, Nos.	1.	2.	3.	4.	5.	6.
Per cent. depreciation.....	36	33	40	37	51	32

or an average of 38. By the last test, made with 20 candle gas, the burners average 27.6 candles to 5 feet of gas, or just 38 per cent. better than a "D" Sugg.

Quoting further from Mr. McMillin, it appears that Nos. 1, 4 and 6 were the larger mantles, and said to be of the American type; 2, 3 and 5 were the smaller mantles of the European type, and perhaps European manufacture. The former were used with ordinary straight chimneys; the latter with tall ones, contracted near the base.

The depreciation of the small burners seemed to be caused by the destruction of the horizontal threads of the mantle at the point of contraction of the chimney. No. 3 (the poorest burner in the lot) did not depreciate after the first 100 hours; indeed, it was better at the end of 600 hours than at the end of 160 hours! No. 2 was considerably shattered, and, during the last 300 hours, had two or three large holes in it, and from the first showed a disposition to disintegrate by the force of explosion that frequently occurs in attempting to light that form of burner.

The American type depreciates chiefly from breaking off at the bottom, and is due to rough usage. The mantles were changed scores of times, and lighted and extinguished hundreds of times. The chimneys were often cleaned, and the burners were undoubtedly exposed to severer tests than would obtain in ordinary commercial use, yet not a burner was broken, and the amount of rough usage they will stand is the most surprising feature about them. In the foregoing, I have quoted Mr. McMillin almost literally

In submitting the report to me, Mr. Humphreys made no reservation, and I trust I have not used it more freely than intended.

I fear I have already consumed too much of the Association's time, but beg a few moments further indulgence. It would be very interesting if we had data similar to the above pertaining to the other forms of incandescent gas burners; and the high duty shown, as compared with the ordinary practice, suggests the query if it is sufficient to offset the additional care required in manipulation and the undoubted increased cost of the burners. I am not authoritatively advised as to such cost, but was informed, some months since, on seemingly good authority, that the complete device—which includes burner, mantle, chimney and shade—would be furnished for $2.50; the renewal of mantles to be 50 cents. If wrong in this I hope to be corrected.

Of the two systems especially referred to I apprehend neither can lay claim to extensive domestic use; although I was credibly informed, three or four months since, of the existence of four plants using the Fahnehjelm system. The Welsbach is younger, and a year ago was almost a stranger in this country.

Both are said to have been materially improved within that time; but it should not be forgoton that the old system, methods and devices have also been improved. Coal gas, in many places, is sold for scarcely more than a third of its cost 15 years ago, and the convenience, simplicity, durability and cheapness of ordinary flat flame burners *must* be *met*, if not by similar points of excellence, by others of a little greater merit. Then, the recent development of high candle power regenerative lamps, and the low price of coal gas makes the task of the electric arc and other new forms of illuminating, including incandescent gas burners, more difficult. It will occur to *all* of us that not only the forms of burners especially referred to, but any form however simple will involve additional cost of appliance, which must be taken into account in estimating commercial results. Answering the query, "Will incandescent burners obtain as a factor in the light of the future?" it may be said: The world moves, and this is an age of improvement in which the fittest will survive—and, possibly, incandescent burners—may I also add, fuel gas?—may be among the survivors.

Discussion.

Mr. King—I think our President can give some facts relating to experiments made subsequent to Mr. Lindsley's paper; and he also may say something in explanation of the figures that will be interesting.

The President—Mr. Lindsley's records, as given here, terminate at 600 hours actual use. Subsequently I made two tests which ran to 1056 hours, but did not preserve the figures. At the end of 1056 hours I made still other tests, of which I kept a record. There was no special object in continuing the test that long, as it would pay to renew the mantle long before the depreciation, being about an average of 38 per cent. I may add, however, that the American type of mantle did not depreciate so rapidly as the foreign specimen—at the end of 600 hours the former was about 6.6 per cent. better than the latter. I was

prompted to continue the readings for so great a length of time simply to determine when they could be said to be completely burned out. The final test was made against different quantities of gas (from 2½ to 3 feet), but I will reduce it in reading, to the corresponding number of candles for a 5 ft. consumption, so that you can compare it readily with the ordinary gas burner. No. 1 gave 20 candles; No. 2, fifteen candles; No. 3 improved in quality after the first hundred hours, but was broken—the wire became so hot that it leaned over against the chimney, and in attempting to straighten it I broke it. The mantle, however, was still as good as ever; No. 4 gave 24.7 candles; No. 5 gave 16.4 candles; No. 6 gave 32.8 candles—this last was actually doing better work than when it was 400 hours younger.

Mr. Murdock—Did Mr. Lindsley experiment any with differently shaped chimneys?

Mr. Lindsley—As said in my paper, I corresponded with various parties, hoping for material with which to experiment, but did not get anything. Consequently I can give no information from personal observation

The President—The European burner is provided with a tall chimney, large at the base, but narrowing 1½ inches above the latter, and again bulging out towards the top. This form is apparently unsuitable, because it is almost impossible to light it from the top. Sometimes you will get half a dozen explosions before a light is secured. With the American mantle an ordinary straight chimney, 8 or 10 inches in height, is used. Many of these tests were made with chimneys only 7 inches high, and all were straight chimneys, save the three or four of European manufacture. The American type of burner with the ordinary straight chimney may be lighted as well from one point as another. They never explode, and never fail to light with a match.

Mr. Murdock—Were your experiments conducted with coal or water gas?

The President—Coal gas, using the Bunsen flame.

Mr. Page—Is the Welsbach burner largely in use in Europe?

The President—I cannot say.

Mr. Lindsley—I think those of us who witnessed the exhibition in Washington street last night perhaps understand that the difficulty in lighting the Welsbach burner has been partly and perhaps wholly removed. We should not allow our minds to be imbued with wrong ideas as to this mattter of lighting back, etc.

Mr. Murdock—I would like to ask Mr. Forstall if he has done any experimenting. He has, perhaps, had better opportunities for it than the rest of us.

Mr. Forstall—We have made no such exhaustive tests of the burner as those reported by the President, and we have no information that will be any more or even as complete as that given by Mr. Lindsley. The Welsbach proprietors have an office in Chicago where considerable testing and exhibiting are in progress.

Mr. King—In response to Mr. Page's question let me say that a short time ago I had an opportunity of talking with a gentleman who had recently been in Vienna. He said the Gas Company there had kept a record of these burners, which they obtained by asking the meter readers to inquire at every house about what the burners were doing. Several thousand burners were in use, but it seemed the maximum amount of favor had been gained. Those who had them in use did not seem to want to discard them, but no great number of new applications for them were made. Not long since the President of one of the English Gas Associations, in his address to the members, said it would be useless now to deny that the Welsbach burner was not gaining ground rapidly in England, and he added that the rivalry between the Welsbach and Clamond types was becoming quite pronounced.

The President—If I am correctly informed as to the European and American types of Welsbach burner, there is about as much difference between the two as there is between an oil lamp and a gas burner, as far as convenience, amount of light, etc., is concerned. They have been greatly improved. Up to the end of 600 hours not a single chimney was broken, except in the instance for which the overheated rod was responsible. The figures given by Mr. Lindsley will enable each man to determine for himself whether there is anything in it or not. Those are the results of tests made about as the burners would be used ordinarily. The servant girl will have no more to do with that burner than she has with those at present in use—she will light and extinguish it in her own room, perhaps; possibly in some of the other rooms—that is all. She would of course have to remove the chimney once in a while to clean it, but not so often as is done with the common Argand lamp. They require no special care. Whether they are just what you want is a matter for each man to determine for himself. You have the figures. Some are poor, and some are good. You can rest assured the tests were made with a view of determining their value. If they are a good thing we want them; if they are not we do not want them. In the tests we did not intend to deceive ourselves, and subjected the lamps to more severe usage than they would have been subjected to in my house.

Mr. Egner—I suppose the object of this discussion is to bring before the Association the subject of incandescent lighting, which we have all got to face. In view of that I would like to state some of my experience with those burners. About a year ago some gentlemen came to St. Louis and wanted to sell us the Fahnehjelm. We having a water gas apparatus at our works, tried it with uncarburetted water gas. We placed a Fahnehjelm burner at one end of a photometer bar and placed an argand on the other end. We found that three feet of our illuminating gas consumed in the argand gave as much light as 5 feet of water gas passed through the Fahnehjelm burner. We could not see any economy in that burner for us, and we did not buy it. There is another objection,—namely, the promoters of the Fahnehjelm process tell us the gas used must not contain any oil, or be carburetted in any way; that if it is, the burner will not give any light. About an hour ago I visited a place where they exhibited this burner, in Chicago, and this is what I saw—5½ cubic feet of uncarburetted water gas burned in a Fahnehjelm burner gave a light .56 per cent. greater than that from 4½ cubic feet of Chicago coal gas burned in the ordinary way. They say the needles will last 100 hours, and that each comb can be replaced at a cost of 3 cents. Knowing these items, and also knowing what it costs to make coal gas and water gas, each member can readily tell for himself whether or not he is in favor of the Fahnehjelm burner for his particular field of labor.

On Motion of Mr. Jenkins, a vote of thanks was given to Mr. Lindsley.

REPORT OF COMMITTEE ON MEMORIAL.

Mr. Chollar, from the Committee appointed to draft a minute to the memory of the late N. W. Jones, presented the following report:

"The Committee to whom was referred the consideration of memorial resolutions in regard to the death of our former associate, N. W. Jones, have been impressed with the idea that, since the frequent appearance of preambles and resolutions in similar cases is somewhat suggestive of cold formality and Parliamentary routine, they would, therefore, suggest and recommend that the sentiment and feeling of this Association be conveyed to the family of the deceased by a letter through the Secretary, and attested by the President, if he deem it best."

B. E. CHOLLAR,
C. M. KELLER,
J. M. MURPHY,
GEO. H. TAYLER,
G. B. BURNS. } Committee.

The report was adopted.

Mr. J. D. Thompson, of St. Louis, Mo., read a paper, entitled

GAS COMPANY'S ACCOUNTS.

The Executive Committee having apparently run short of subjects pertaining to the manufacture of gas, has turned its attention to another branch of the business, viz: "Gas Company Accounts," and has called upon me to be the pioneer in opening up its discussion.

It is proper for me to say, in the outset, that the system I shall lay before you is the outcome of my experience only. I have had but few opportunities to compare it with that of other companies, and I cannot therefore assume that it is any better than yours; but by it I claim to be able to know each month, or each year, just what is being done in every department of the business, and by comparing item by item, one period with another, mark the progress towards economy, or, when one item appears large in comparison, review the cause of that increase, and, if possible, guard against it in the future.

The cost of gas in the holders is a far more important matter now than it was a few years ago, when all gas was made from coal, and in about the same way; now, the patent process man is abroad, claiming to be able to do you wonders, and you must be in a position to know how much, if any, he can save you. As the expenses attending the distribution from the holder to the burner, the collection of bills and the management of the business outside of the works, as well as the leakage or accounted for gas, are matters which will not materially vary, whatever may be the process of manufacture, the importance is seen of keeping the manufacturing department in its own proper place.

As I write this, it seems to me absurd to tell men what is so self-evident, but I happen to know that there are companies, and large ones, too, whose accounts are kept in such a crude state, that it is impossible to ascertain by them the cost of gas at the holder, or even separate the actual expenses from the total expenditures for new construction or betterments. My theory is, that the plant and equipment, when once paid for, should always be kept in perfect condition; every dollar needed for that purpose should be charged to repairs in the current

expense account; when retorts give out and benches are taken down and replaced by new ones, or any part of the machinery is renewed, such expenses, as well as the daily needs in little things, constitute a part of the current cost of gas; but when new additional machinery is added to the existing plant, when the number of benches is increased, new holders erected, or any thing done which adds to the capacity of the works, such items should be charged to construction account.

In like manner the meter account is treated; we start out in the beginning with a certain number of meters sufficient to handle the business; they constitute an item of equipment account; any money or time spent in keeping them in order, or in replacing condemned meters with new ones, belongs to expense account; new meters which add to the original stock, go to the equipment account. The same treatment is applied to the outlay for street mains and lamp posts.

In comparing results obtained by different companies in the cost of gas in the holders, it is easy to see that from want of uniformity as to what items go into that calculation, one company may apparently be producing its gas at a less figure than another, while in fact its work is costing more money.

In my statement I have a column showing the cost of every 1,000 feet of gas made, and another showing the cost of every 1,000 feet sold; these calculations are carried for each item in the expense account to the one hundredth part of a cent—the difference between these columns shows what is being lost by leakage, and is more comprehensive than the mere statement of the percentage of leakage. By thus being constantly informed of what one is spending per 1,000 feet for each item, and comparing it with its corresponding period, he is often able to put his finger on a weak spot which would otherwise pass unnoticed. While with coal and labor this percentage may keep pace with the quantity of gas made and sold, it is interesting to note how in other things it will have a constant downward tendency as the volume of business increases.

The more one studies such statements, familiarizing himself, not so much with the grand total as with each item going to make up that total, and comparing it with previous corresponding periods, the more he will become fascinated with the figures, and ambitious to improve upon them. It affords me great pleasure to look over my annual statements for the past ten or twelve years, and note what a steady stride has been made in the right direction, enabling us to sell gas now for less money than it once cost to make it, and yet continue the payment of regular dividends; the large increase of consumption is, of course, an important factor in this result, but it is by no means the only one; increased economy in every department can be traced year by year, and the steady march still goes on.

Here is a leaf from my monthly statement book which shows how the various items going to make up the expense account are distributed. [See blank form, this page.]

Expense Account for the Month ending .....18..

	Cost per 1,000 Feet of Gas.			
	Made.	Sold.		
Coal				
Oil				
Less Coke				
Tar				
Ammonia				
Salary of superintendent				
Labor at works				
Repairs at works				
Lime				
Incidentals				
In Holders—				
Salary of inspector				
Labor in inspector's department				
Street main repairs				
Lamp post repairs				
Meter repairs				
Services				
Sundries				
Distribution—				
Office rent				
Office expenses (station'y, print'g, etc.)				
Office salaries				
Sundries				
Collection—				
Executive expenses				
Legal expenses				
Taxes				
Insurance				
Interest				
Sundries				
Total expenses				

			Cubic Feet.	Cash Received
Private consumption				
" "				
Public lamps				
Total sales				
Works, office, and D. H. list				
Leakage				
Total output				
Expenses				
Net earnings				

Your worthy President, in his letter asking me to prepare this paper, called my particular attention to the subject of "How consumers' books should be kept." This is certainly a matter of great importance. I have heard it said that the best system was the one which gave the least trouble and took the shortest time in which to collect bills. I cannot agree to any such opinion; for, if it were true, consumers' accounts might be kept on a blackboard or slate, and when payments were made the marks on the slate might be rubbed out and all would be over. We deal in a commodity which is peculiar to itself, having no parallel in any other branch of business. If the purchaser could see his goods measured or weighed out to him, he would know that he received what he was asked to pay for; and, after settlement was made, the question of the amount sold might not need recording; but gas is an intangible substance, it comes at one's beck and call, shedding its brilliancy and illuminating presence about the user, remaining for not one instant beyond his wishes, yet never tiring, and always at his command. He never sees it, and needs no room in which to store it; and, as a natural consequence, does not realize how much he has used it—the only thing he is sure of is that he did not use as much as he did last year. The silent monitor in his cellar, carefully recording every movement of the gas in reaching his burner, is to him a mystery, if not a fraud.

How indispensable, therefore, it is that a true record should be kept by the company of the payments made by each consumer. The business is *not* done when a bill is paid; for it is again and again referred to, in comparison with subsequent bills of the same party, as well as with the bills of others—his neighbors, who did not have so much to pay.

From the accompanying sheet [see next page], taken from one of our ledgers, you will see what record I think it is necessary to keep. We open an account with each person to whom a meter is supplied. These accounts appear upon the ledger in the alphabetical order of streets and their house numbers, making it easy to turn to any particular account. The first column shows the date of observation of the meter, followed by its register, the amount of consumption, and the value of same in dollars and cents; from this the bill is then made out. The credit side shows the date of payment, the discount allowed, and the amount paid.

As the cash comes in, the teller records each payment in his cash book, giving the folio of the ledger, the name of the party, the discount and the cash. Our ledgers have (each) 500 pages, with two accounts on a page. Each bookkeeper has a journal, in which he enters, from the teller's cash book, the items which pertain to his ledgers, picking them out from the folio column thus: The first bookkeeper, having four ledgers with folios running from 1 to 2,000; the second with folios 2,001 to 4,000, and so on. The total footings of these journals must agree each day with the total amount recorded in the cash book. From the journals the bookkeepers post into the ledgers.

Ledger Sheet, Showing Two Accounts.

WILLIAM S. SMALL,

Dec. 10, 1883. 1807 JEFFERSON AVENUE.

Deposit, $10.

			Dr.			Cr.	
Date of Observation.	State of Meter.	Consumption.	Amount.	Date of Payment.	Discount.	Amount	Remarks. Meter, 5 A. M. No. 419,276.
1883.							
Dec. 15	0	.....	.....	.....	.....	.....	
1884.				1884.			
Jan. 2	23	23	$3 68	Feb. 9	$0 23	$3 45	
Feb. 29	54	31	4 96	Mar. 10	31	4 65	
Mar. 31	87	33	5 28	April 7	33	4 95	
April 30	115	28	4 48	May 13	.....	4 48	
May 31	137	22	3 52	June 9	22	3 30	
July 1	147	10	1 60	July 11	10	1 50	
		147	$23 52		$1 19	$22 33	
July 31	155	8	$1 28	Aug. 12	$0 08	$1 20	
Aug. 30	166	11	1 76	Sept. 9	11	1 65	
Sept. 29	183	17	2 72	Oct. 25	02	2 70	Off on 30th; on on 2d th
Nov. 1	206	23	3 68	Nov. 11	23	3 45	
Dec. 1	247	41	6 56	Dec. 11	41	6 15	
" 9	262	15	)				) O.K.
" 9	196	.....		1885.			M.R. 5 A.M., 419,276
" 31	227	31	) 7 33	Jan. 12	46	6 90	) Reset 5 A.M., 394,479
		146	$23 36		$1 31	$22 05	
1885.							
Jan. 31	272	45	$7 20	Feb. 12	$0 45	$6 75	
Feb. 7	280	.....	.....	.....	.....	.....	
" 28	294	22	3 52	Mar. 11	22	3 30	

T. S. COLLINS. Feb. 28, 1885. (Change of name.)

Mar. 31	317	23	3 68	April 10	23	3 45	
April 30	330	13	2 08	May 9	13	1 95	
May 30	340	10	1 60	June 16	.....	1 60	
June 30	346	6	96	July 9	06	90	
		119	$19 04		$1 09	$17 95	
July 31	353	7	$1 12	Aug. 7	$0 07	$1 05	
Aug. 31	364	11	1 76	Sept. 12	11	1 65	
Sept. 29	372	8	1 28	Oct. 13	.....	1 28	Bl to 906 Gay street.
Oct. 6	375	3	48	" 12	03	45	M.R. 5 A.M., 394,479.
		29	$4 64		$0 21	$4 43	

CHARLES G. JONES,

19,606. 1809 JEFFERSON AVENUE.

Deposit, $10.

			Dr.			Cr.	
Date of Observation.	State of Meter.	Consumption.	Amount.	Date of Payment.	Discount.	Amount.	Remarks. Meter, 5 H. G. No. 101,272.
1883.				1883.			
Oct. 30	290	.....	.....	.....	.....	.....	
Nov. 30	308	18	$2 88	Dec. 8	$0 18	$2 70	
Dec 29	313	5	)				
1884.				1884.			
Jan. 31	336	23	) 4 48	Feb. 9	28	4 20	
Feb. 29	358	22	3 52	Mar. 6	22	3 30	
April 1	378	20	3 20	April 8	20	3 00	
May 1	396	18	2 88	May 7	18	2 70	
" 31	412	16	2 56	June 6	16	2 40	
June 30	426	14	2 24	July 9	14	2 10	
		136	$21 76		$1 36	$20 25	
July 31	438	12	$1 92	Aug. 7	$0 12	$1 80	
Aug. 30	.....	.....	.....	.....	.....	.....	In country.
Sept. 29	454	16	2 56	Oct. 10	16	2 40	
Nov. 1	474	20	3 20	Nov. 11	20	3 00	
Dec. 1	504	30	4 80	Dec. 6	30	4 50	
				1885.			
Dec. 31	539	35	5 60	Jan. 8	35	5 25	
		113	$18 08		$1 13	$16 95	
1885.							
Jan. 31	579	40	$6 40	Feb. 7	$0 40	$6 00	
Feb. 28	620	41	6 56	Mar. 6	41	6 15	
Mar. 31	658	38	6 08	April 9	38	5 70	
April 30	680	22	3 52	May 8	22	3 30	
May 30	702	22	3 52	June 6	22	3 30	
June 30	720	18	2 88	July 9	18	2 70	
		181	$28 96		$1 81	$27 15	
July 31	736	16	$2 56	Aug. 8	$0 16	$2 40	
Aug. 30	740	4	)				
Sept. 29	760	20	) 3 84	Oct. 9	24	3 60	
Oct. 31	782	22	3 52	Nov. 10	22	3 30	
Nov. 30	812	30	4 80	Dec. 8	30	4 50	M.R. 5 H.G., 101,272.
		92	$14 72		$0 92	$13 80	

When the last discount day is over the bookkeeper makes out a list of bills unpaid, and sends a notice to each party, calling his attention to the fact that he has overlooked the payment of his bill, and that, if it is not paid on or before a certain date, the gas will be shut off. When the allotted time has expired the order to shut off goes out. Some persons make it a rule to pay only when the man comes to turn off the gas. In such cases the man collects the amount due and returns the shut-off ticket to the office with the money. When the gas has been "off" for a couple of days, and the bill is yet unpaid, the meter is removed.

One page of this ledger will thus record each customer's monthly account for three years, and will show at a glance every particular of it, viz:

When he pays his bills promptly and gets his discounts; when he has been nursed and had his time extended; when and how often he is shut off for non-payment, and any compromise settlement which may have been made with him. If a meter is complained of and taken out and tested, the record of that test is there recorded, and when the meter is removed, and a balance remains unpaid, that fact will there stand ready to be presented to the party if he should ever again apply for gas.

We have thus a complete history of every consumer, ready to open it out upon him whenever occasion demands. Once in six months these pages are carefully footed up, first, to see if errors have been made, as the total consumption for the six months must agree with the difference between the meter registers; then that the amount in dollars and cents is correct for that number of feet, and that sum shall equal the total discounts added to the total payments. Then, on a balance sheet, these footings are taken down and all summed up in one grand total, which must also agree with the total cash received from gas, as shown by the books of the Secretary.

All this work requires some clerical force to keep up, but it is an expense which well repays its outlay, affording, as it does, a means of detecting and remedying any errors made by the bookkeepers, and a valuable check upon any attempt at false entries or misappropriation.

Discussion.

Mr. King—I think no one can help appreciating the system of accounts which Mr. Thompson has presented. In view of the importance of the subject, I move that a committee be appointed (of which Mr. Thompson shall be chairman), to report upon and recommend a system, at our next meeting, which shall be a standard for comparisons. I think a system should be formulated by the committee which would accommodate not only the larger but the smaller companies—something like that which the Massachusetts Gas Commissioners have formulated. We could then make proper comparisons in attempting to arrive at what we all are doing.

[The motion having been seconded and placed before the Association, the discussion was proceeded with, as follows:]

Mr. King—In large works having separate departments, and where the Superintendent is concerned only with the manufacturing department, it is very clear that his services are to be charged to that department; so also in the case of the distributing department, and so on. In smaller works perhaps one man does it all. Hence we should have some standard method of arranging our accounts so that certain portions of the service should be separately charged under their appropriate headings.

Mr. Robinson—What do you do, Mr. Thompson, with those who never pay? Do not such delinquencies, either directly or indirectly, increase the cost of gas in the holder? In other words, a company with a collector who manages to collect, say, within 3 per cent. of all the bills, will, so to speak, have put its gas in the holder at a lower rate than in the case of another company which collects only 90 per cent. of its bills.

Mr. Thompson—My plan is to compare the amount of gas made with

the amount of cash received. It is just as if it had not been sold, until the cash comes in. When it comes in the gas is credited with the amount paid. Any outstanding accounts are not figured on at all, unless there happens, for instance, to be a month in which a large payment from the city is due, or some other account which goes over until the next month. I carry that over, then, not as a delinquency, but as a something which I am sure is going to be paid next month. Ordinary delinquencies are not taken any notice of in the monthly statement.

The President—Gas Commissioner Barker, who has been all through this task of arranging for a uniform system of gas accounts in Massachusetts, is present, and we would be glad to hear from him on this subject.

Mr. Barker—As said before, I did not anticipate taking any part in these discussions; but the system described by Mr. Thompson, at least so far as he explained it, is very close to the system adopted by the Commission, as required by the statutes of Massachusetts. I would like to ask Mr. Thompson how large the output of a company ought to be before it can afford to keep such a system of accounts as that outlined by him; and also in respect to certain details, such as the following: What he would do with the expense for the renewal of mains, when it becomes necessary to take up a small one and replace it with a larger; whether he takes account of the gas in the holder at the close of the year when he closes his books and makes his balance sheet; and whether any mention of the gas in the holder goes into the balance sheet as assets. The system of accounts which the Massachusetts Board have been required to keep, I think, has been very generally adopted by the companies; and it affords to the Board (although the details of the returns have not been published), and to the companies (which have access to them), a very ready and reliable method of comparing the work of one company with the work of others. I think the plan has been as shown, in one or two instances which have been made apparent to us, of very great practical value to the companies themselves.

Mr. Thompson—In answer to the first question, I would reply that I think any company can—no matter how small. Of course where one man has general charge of the whole system it is proper to apportion a certain amount of his salary to the cost of manufacture, another portion to the cost of distribution, and a certain further amount to the other things—that is, if you want to keep the whole thing separate, as it ought to be done. If there are only a hundred consumers it will pay to keep their accounts in the style proposed. I think that if small mains were taken out and larger ones put down, the additional cost of the larger mains should be added to the construction or plant account. Our practice has been when a main was found to be inadequate to the greater duty in time imposed upon it, to put down a larger main on the other side of the street, allowing the smaller one to be undisturbed. As to the amount of gas in the holder—with us this remains so nearly stationary that I do not separate it. I do not each month take account of that, for the reason that it is a very small item as compared with others. Usually it is about the same thing with us from month to month. However, it would of course be very easy to figure on that in addition to these other items.

Mr. King—How about the coal?

Mr. Thompson—The quantity of coal on hand each month is very carefully estimated.

Mr. King—And the tools, fixtures, etc., go in every month?

Mr. Thompson—Yes; but that is an estimate more than a reality. We estimate a certain amount on hand in the equipment account at the close of each month. The coal account is kept accurately. When the coal comes in it is charged with its cost, and it is credited each month with the amount used, according to the cost.

Mr. Lansden—I think the system of keeping the meter account of each consumer all on one page is a good thing; and believe you will find it to be of the greatest benefit in regard to satisfying a discontented consumer. If a consumer wishes it, you can lay before him an accurate and concise statement of what his bills have been, and what quantity of gas he has burned during the last three years. I wish to ask Mr. Thompson if he does not think that that is one of the most important features of his system?

Mr. Thompson—That thing in itself is worth the entire cost of keeping the account. It is no unusual thing for a consumer to say he did not burn that much gas last year, or the year before; but when we place his account right before him he can see every item of it for a period of three years.

On motion of Mr. Robinson, a vote of thanks was tendered to Mr. Thompson.

[The motion of Mr. King was then adopted, and the President thereupon named the following "Committee on a Uniform System of Gas Accounts:" Chairman J. D. Thompson, St. Louis, Mo., Geo. G. Ramsdell, Vincennes, Ind., and A. W. Littleton, Quincy, Ills.]

ELECTION OF OFFICERS.

Mr. Lindsley, Chairman of the Committee to Nominate Officers, reported the following list:

For President—Geo. G. Ramsdell, Vincennes, Ind.

For Vice-Presidents—E. J. King, Jacksonville, Ills.; A. E. Boardman, Macon, Ga.

For Secretary and Treasurer—A. W. Littleton, Quincy, Ills.

For Board of Directors—L. K. Scofield, Fort Scott, Kans.; Fred. Egner, St. Louis, Mo.; C. R. Faben, Jr., Toledo, O.; Carroll Collins, Murfreesboro, Tenn.; E. H. Jenkins, Columbus, Ga.; C. M. Keller, Columbus, Ind.; A. H. Barret, Louisville, Ky.; Theobald Forstall, Chicago, Ills.; G. A. Hyde, Jr., East Saginaw, Mich.

On motion of Mr. Howard, Mr. Lindsley was instructed to cast the ballot of the Association in favor of the election to office of the candidates reported by the committee. Mr. Lindsley having performed this duty, the President declared the result, which was received with applause. In response to several calls President-elect Ramsdell said: Gentlemen, I have to thank you most sincerely for the honor you do me. It is hardly necessary that I should speak to you in any set phrases; but permit me to assure you that I appreciate the position and its responsibilities. My fealty to this Association has never been questioned, and my earnest wish is that during my period of office its interests shall not suffer. I shall do all that lies in my power to forward its prosperity, and shall aim to cause our next gathering to be even more successful than this one—if that is a thing possible of accomplishment. Permit to renew my acknowledgement of your kindness. (Applause.)

A recess, to terminate at 2 P.M., was ordered.

SECOND DAY—AFTERNOON SESSION.

When the afternoon session was called to order, Mr. Dunbar called up the amendment to the by-laws (offered by Mr. Emerson McMillin, at the meeting in St. Louis, Mo., May, 1887), providing for a change in the method of choosing Honorary Members. The Secretary here read the proposed

AMENDMENT TO THE BY-LAWS,

which is as follows:

"The Board of Directors may in their discretion recommend to the Association, for election to Honorary Membership, persons who may be eminent for their skill, or mental acquirements, in the manufacture of gas or gas engineering, and when so recommended the name or names so proposed shall be voted on, in the usual manner for election to active membership.

"Honorary members shall not be required to pay dues."

The amendment was adopted without debate.

Mr. Frank Bierce, of Memphis, Tenn., here read his paper on

HALF-DEPTH REGENERATIVE FURNACES.

Mr. President and Gentlemen: This mite of contribution, which is cheerfully given, is intended as a practical, common sense recital of an experience and conclusions obviously deduced, rather than an attempt to digest the science of furnaces.

First. What constitutes a full depth regenerative furnace?

Answer. I do not know; *i. e.*, I do not know how to characterize the difference between a full-depth and a half-depth. Did I know there was a distinguishable difference, and what constituted such difference, I might be better able to characterize my subject, "half-depths," by classification. Commonly speaking, as I understand it, a full-depth regenerative furnace is anywhere from 5 or 6 feet, to 12 or 15 feet, according to fancy. Therefore, on this hypothesis, a half-depth regenerative furnace should be anything from 2½ to 7 or 8 feet in depth, provided it is regenerative in principle of construction.

Second. What is regenerative, as applicable in the sense of a furnace description?

Answer. My answer is: It is the transformation of carbonic oxide to carbonic acid by the admission of secondary air at the proper point to aid in perfecting combustion, or in utilizing much

of the product that might otherwise escape unconsumed; and this should be admitted in a manner to not detract any more of the heat than necessary from the point where as much as possible of the heat is calculated upon being utilized. To carry out this idea in profitable practice, the simpler and more inexpensive the device in proportion to the results is the thing in furnaces the man with a regenerative turn of mind is looking for; because, in turn, this means economic use of fuel.

With this much as preliminary, I will devote myself to sharing my experience, and my ideas, deduced from what I have seen.

I built last fall 10 benches of sixes, 14-in. by 26 in. by 9 ft. retorts. Am glad of it; wish I had built more; am going to build more. Why? Because, visiting around extensively, examining and studying, I found that the object sought was a furnace that would most economically produce the required amount of heat—the cost of erection entering as a factor in the solution of the problem to me.

Bear in mind I am only relating an experience with half-depths, and some observations of all kinds; therefore, I add right here I am so situated that I could not excavate low enough for deep furnaces on account of high water interference, and choose not to elevate because having stacks of arches that were good I did not want to abandon them. With these facts, I would not excavate, if I could, or elevate, either, for the reason I became sufficiently satisfied that I could, with a shallow regenerative furnace, on a four hours' run produce sufficient heat to carbonize as much coal of the kind I use (Pittsburg) as the retorts would carry without suffocation to get from the coal a maximum of the illuminant with a minimum of fuel and labor in keeping with my ambition at that time.

It is, I believe, asserted, if not conceded, that a good quality of carbonized oxygen is not produced by the passage of air through a bed of fuel less than 2 feet deep, when gas coke is used, from the accustomed draughts in the flues of any ordinary coal gas bench. It is my observation that good carbonic oxide is produced only from at least a 2 ft. 6 ins. depth of gas coke, when draughts are not impeded and a somewhat lively draught is required, unless the furnace be extraordinarily deep; therefore, I should say, as the result of my observation on this point—make the fuel chamber at least 3 feet 6 inches deep, for the reason that, in replenishing once in four hours only (and I believe that it is one aim with all regenerative furnaces to replenish as seldom as possible), a furnace of this depth, and proportioned in width, to be filled full when replenishing, with not over 33 per cent. of the coke drawn from the retorts above, will, in practical use for good results, consume down a foot or more to a point where there is no longer a good quality of carbonic oxide produced in the combustion below; and this is readily determinable from the color of the product of combustion as it emerges from the top of the fire; also from the rapidity of combustion below that point, and its receding distance from the retorts.

I believe no one will deny the claim that a large fire is hotter than a small one of same degree of incandescence. Now, the combination of these two facts, a large fire and a thorough carbonization of the oxygen, is the fundamental basis of furnace heats as I view the subject; and, starting out once more from this point of consideration, what is sought is the constructive device for regulating this combination in the most economic consumption of fuel. Following along this line of illustration, a deep furnace is hotter than a shallow one. The reason is clear to me that the oxygen, the agent of combustion, is carbonized in a stronger degree, which, as an extremity, means, that if you make one deep enough and put steam enough under the grate bars, so as to press the combustion area up as near the retorts as possible, at same time giving it a strong draught, one can quickly destroy the retorts above; whereas on the other hand, if properly constructed in regenerative principle, the oxide can be converted to acid to any desired extent, and at same time the rapidity of combustion checked by dampers on the primary air supply, both compensating each other in proportion to the amount of waste products of combustion issuing from the exit chimneys, as in comparison with the degree of heat attained upon the retort, which is the objective. For example, if not enough heat on retorts and too much waste products, more secondary or less primary air; and, then, again, if not enough heat on retorts, and no waste products, and yet a rapid combustion, it is shown that the product of that combustion is spent—*i. e.*, the chemical union takes place (at which point is the center of heat) too low down in the furnace; so just give the furnace some more steam from below, in order to drive or press forward or upward the point of that chemical conversion, causing it to take place where you want it—among the retorts above instead of in the furnace below. This latter, however, I have found to be fruitful of luxuriant growth of clinker (a chemical combination not much desired) and has its disadvantages.

In this connection it is also my experience, as well as observation, that sufficiently good results are accomplished with a furnace such as I have for my subject, with diligent use in the hands of competent persons, for as profitable distillation of coal in the retort system in benches of sixes as I have seen from very deep ones; for it may be said, I think, practically speaking in a general sense, that just so much gas of a given quality can be taken from a given quantity of coal and no more, and that a given sized retort can be charged with just so much coal for perfect carbonization, and no more, and that a retort will stand just so much heat, according to how much coal is being distilled in it, and no more, without its too rapid destruction, the object being to accomplish these things by as short a process as possible. Here, then, enters the great agent of complication in all scientific investigations—that of cost and compensation.

A shallow regenerative furnace can be built much cheaper than a deep one, and the life of the two, I imagine, should be about the same. My furnaces cost me between $500 and $600 each, including retorts and mouthpieces, the arch filled complete and connected up; and I have seen deep ones that were said to have cost several thousand each. Looked a little extravagant! However, the difference is great in cost, and little, if any, return in compensation, is my conclusion, after comparing results carefully.

The ones I built are not exactly like any that I have seen elsewhere, although in principle very similar to some. I do not think them any better than some I have seen; but yet they seem to me to be quite as good as any. Some that I built differ from the others a trifle, although (as in the other comparison) in principle similar, and so near alike as to accomplish practically the same results.

With the same fidelity to a deep furnace I have to a shallow one, I must say that I believe a deep furnace can be manipulated much more easily than a shallow one, considering the character of common labor in a gas works as a rule, and the measure of intelligence employed in furnace stoking. That the successful or profitable use of a deep regenerative furnace can be more readily depended upon, because it requires less attention and the exercise of less judgment, its advantages being more easily comprehensible, as it appears to me, and in this aspect of treating the subject, as by comparison, of half-depths with full-depths, I do not feel that what I have to say is fully competent, for it may be the experience of others who have tried both that enough saving is accomplished in the way I have intimated as possible to affect the difference in cost, and perhaps in other ways, without my experience and not concurring to my mind or my view; therefore, in the pleasure of giving what I have, it is submitted only for what it may be worth.

It would perhaps be interesting to have shown briefly some comparison of results between the old primitive design of furnaces and the half-depth or shallow regeneratives, as I am operating some of each right alongside of each other, only in separate stacks, so that heats are not contiguous, and I get as good carbonization of 50 per cent. more coal, from a half-depth regenerative, at an expense of not over 30 per cent. of the coke, as I do from the old design with a consumption of nearly, if not quite, 50 per cent. of the coke; besides averaging 6 retorts instead of 4 retorts to the man with the old design, without imposing any more labor on the men beyond that it is hotter work.

Another thing of by no means secondary importance in connection with half-depth or shallow regenerative furnaces, is the method of introducing the hot coke immediately from the retorts into them—an indispensable adjunct. I had not seen a very systematic arrangement for feeding them, and I spent some thought on this feature. My hot coke is drawn from the two top retorts, at same time, through a funnel into the furnace below, this funnel being a very unique implement for the purpose, and original in design. In resemblance it impresses one with the idea of the spread eagle. It bears the cognomen among the negro laborers using it of the native Southern bird, the "Buzzard." I hoist it out of the way overhead, when through using it, by means of a quarter-inch wire tiller-cord over a couple of three inch pulley blocks and a small windlass—home made—and likewise lower it in a jiffy into position for use in the same way, the operation being quick and neat. The funnel, being always suspended in the air, is always in its place and

out of the way of everything and everybody. Is at once useful, handy, comparatively cheap, entirely simple, and its utility indispensable in connection with furnaces constructed as mine are. I would not speak of this hot coke funnel, except that I have come to regard it a part of the system of shallow regenerative furnaces in utilizing the coke in its incandescent condition—*i. e.*, something of the kind for the purpose; and this was the simplest, cheapest and most accomplished device within my conception. Its origin being the result of necessity, which is often the agent of contrivance, something had to be contrived to compete with mechanic-like construction of the deep regenerative furnace in this respect.

Discussion.

Mr. Jenkins—Does Mr. Bierce use the ordinary setting of furnaces, or does he reconstruct the arches?

Mr. Bierce—I rebuild the arches completely below the level of the old design of setting. I think it is necessary to reconstruct the arches.

Mr. E. L. Brown—How deep were the old pits?

Mr. Bierce—The fuel beds in my furnaces are 3 ft. 6 ins., and below that we have the ordinary ash pit.

Mr. Dunbar—In speaking about the combustion taking place in the furnace instead of sufficiently enveloping the retorts, you say that, by turning on more steam from below, the chemical conversion can be made to take place where you want it—"among the retorts above, instead of in the furnace below. This latter, however, I have found to be fruitful of luxuriant growth of clinkers." Do you mean, by turning more steam into the furnace, you get more clinker there?

Mr. Bierce—That is my experience.

Mr. Dunbar—My experience is quite the reverse. The more steam that was passed in the less was the clinker.

Mr. Bierce—Of course the clinker formed when the larger quantity of steam was passed in was softer than when less steam was used.

Mr. Dunbar—How often do you find it necessary to clinker?

Mr. Bierce—Once in 24 hours.

Mr. Dunbar—I work a bench of threes on the same plan, and I find a great saving over the old system. I can increase the production of the retorts 50 per cent., and do not find it necessary to clinker nearly so often. We use considerable steam, and the clinker is very soft.

Mr. Bierce—Perhaps you get better results than I do. You may carbonize more coal than I do from the simple fact that you do take more steam under the grate bars.

Mr. Dunbar—I have a pipe running under the grate bars on each side, the holes being 8 inches apart, and the steam is going into the furnace with such force that you can hear it 10 or 12 feet off.

Mr. Bierce—It is the same with me. I use a three-eighth pipe.

Mr. Dunbar—I have a three-eighth pipe, with 1-16 inch holes, 8 inches apart.

Mr. King—What pressure do you carry?

Mr. Bierce—A pressure of about 50 pounds at our boiler.

Mr. King—The item of steam would be something in figuring the cost, and in the saving of coke.

Mr. Bierce—I think it would be only nominal.

Mr. King—You use coke breeze for making steam?

Mr. Bierce—Yes.

Mr. King—I confess I have been very much interested in this paper, and have obtained a number of new ideas from it. In the small works of which I have charge they never deemed it worth while to incur the expense of improved firing, but I am always interested in seeing what others are doing, and the nearer I get to the point where I can see my way clear to getting better results, the better I am pleased. I understood you to say that the arches had to be rebuilt.

Mr. Bierce—Yes.

Mr. King—Would there be no way of reconstructing them?

Mr. Bierce—Not the stack; but simply to excavate for the settings.

Mr. Jenkins—I asked you if you had to reconstruct the arches.

Mr. Bierce—Then I did not understand you. I use the old stack, and simply excavate the settings.

Mr. Jenkins—Suppose I have a stack of 3 benches of sixes, and wish to put in new retorts. Can I go under that arch and build my regenerator works below?

Mr. Bierce—Yes; a little below the level of the old setting.

Mr. Dunbar—How do you let the primary air in? Do you heat it, or admit it directly under the furnace?

Mr. Bierce—Directly under the furnace.

Mr. Dunbar—I was told not to admit very much air there; that I could not work the fire from below. I find that with a small amount of air admitted I cannot work the furnace successfully. Do you keep your grate bars so that you can see the reflection from the fire in the water of the ash pan below?

Mr. Bierce—I find I have to keep the ash-pit door open and give an abundance of air.

Mr. Gimper—In our Leavenworth works we have been running regenerative benches since 1882, and I find we do not want to run much steam on them. If we do we have the same trouble as that of Mr. Dunbar in the item of clinker formation; but we want to control the primary air very close down, admitting enough only to make sufficient carbonic oxide and furnace gas, and then add the proper amount of secondary air, which is heated, to complete the combustion above the furnace. We clinker once in 24 hours. We have run our benches sometimes for 36 hours before clinkering. The steam supply is of very great importance—not to allow too much, because in that event you cut the heats down. Our opening for the primary air is about three-quarters of an inch by 2½ inches. That opening is sufficient for the primary air when the bench is in good working order.

Mr. Bierce—What is the depth of your furnace?

Mr. Gimper—I have a deep furnace.

Mr. Bierce—If I have the correct conception of the principle of carbonic oxide, a slow process of combustion of the oxygen through a bed of fuel can be had with a deep furnace, whereas, with a shallow one, you must have a rapid combustion in order to take up as nearly as possible one equivalent of carbon to each equivalent of oxygen which passes through. As I understand it, the deeper your furnace the slower combustion of oxygen enables you to produce a good quality of carbonic oxide. That is, you approach a perfect carbonic oxide. If you have a deep and very hot furnace it would require a very slow combustion of the air through that to produce a very good quality of carbonic oxide; whereas, with a shallow furnace you would have a rapid combustion of air through there.

Mr. Gimper—How large an opening have you to admit the primary air?

Mr. Bierce—I throw the ash-pit door wide open, and check with the dampers on the secondary air.

Mr. Gimper—I did that for the first two weeks, until I knew just how to handle it. Then I shut the door as close as I could, and when it warped I put on luting so as not to let in any more air pass in than I wanted for my purpose.

Mr. Bierce—You have a deep furnace, whereas I have a shallow one. There is where the difference lies.

Mr. McMillin—How many pounds of coke do you charge?

Mr. Bierce—I have not kept a detailed account of the consumption of coke, but I know we use something less than 30 per cent.

Mr. Jenkins—How long are your charges?

Mr. Bierce—We operate on four hours' run. I put in from 1,500 to 1,800 pounds to an arch, of Pittsburgh coal.

Mr. King—Do you have stopped standpipes?

Mr. Bierce—None at all. We have 7-inch standpipes—we had 5-inch pipes, but removed them—and that is probably the reason.

On motion of Mr. King a vote of thanks was passed to Mr. Bierce.

The President now introduced Professor T. C. Mendenhall, President of the Rose Polytechnic Institute, of Terre Haute, Ind., who was greeted with applause. When quiet had been restored the Professor delivered the following lecture on

PHOTOMETRIC STANDARDS.

Mr. President and Gentlemen of the Association:—At the outset I want to confess I thought more than once before accepting the kind invitation of your President, to bring my coals to your Newcastle, or, as that is a very much worn and threadbare expression, perhaps I might better say, to bring my gas to your meter. But your President was kind enough a few weeks since to revive my courage a little by sending me printed reports of previous discussions upon the subject of photometry and photometric measurements, which had been had in this and in other kindred associations, and the perusal of these, to me exceedingly interesting papers, revived my courage, in that it convinced me that, even if I were to do my very worst, I could perhaps add but little to the confusion which already exists in the minds of most of us in connection with photometric stand-

ards and photometry. I trust, however, in my brief discussion of the subject, that, if I am unable to give you any information which is new (and there will be little I imagine that will be new, because the subject has been so thoroughly talked about among you in years past), I may perhaps be able to treat the subject from a standpoint somewhat different from yours. Another reason why I had the courage to come here was because it is a pleasure to me to give a talk upon this subject to gentlemen who are so greatly interested in it, for, perhaps, there is no other body of men in the country who are really so deeply interested in the matter of photometric measurements.

I suspect it has very often occurred to you that you are in the somewhat anomalous position of having an article for sale, and selling it constantly, and yet not being able to measure the quantities that you sell with any degree of accuracy. There are not many merchants or commercial men who buy or sell, who are in that position. I make a distinction, (and I imagine that all of you have long ago made the same distinction) between selling gas and selling light; and between selling gas and selling heat. And in the same way I might make a distinction between selling electrical energy and selling light or selling power. I will not question the fact (for it is very well known to everybody) that your device for measuring the quantity of gas that you dispose of to your customers is accurate—I suppose it would be heresy to question the accuracy of that well-known device; but, nevertheless, it is an instrument for measuring the quantity of gas which you sell to the consumer, and not the quantity of light which you furnish him. Your customer, in the main, buys light; he does not buy gas. In many instances he buys heat; he does not buy gas, but the heat which it will produce. So, also, the customers of the electric light companies buy either light or power rather than the electrical energy which produces the light or the power. The problem which they have before them is really the same problem which you have before you—namely, how to measure the thing which is bought and sold in these transactions. Now, without further preliminary, let us address ourselves for a moment to the

Nature and Requisites of a Standard.

What is meant by a standard? What are the characteristics of a standard? This has long been settled in ordinary measurements and transactions. We have no difficulty in measuring lengths, or in measuring masses, or in measuring times, because our standards were definitely fixed for us many years ago. Some of the requisites of a standard are, first of all, that it shall be constant; that is, it must be constant as to place, and also constant as to time. It must be the same to-day that it was yesterday; and we must have the assurance that it will be the same to morrow. And it must be the same in the city of Chicago that it is in the city of Indianapolis, or in any other city in the country. These are the two primary requisites. There is another which is very important, which is that it must be a standard at once convenient and readily accessible to all. Another requisite is that the standard may be readily and easily applied to the thing which is to be measured.

With this summary of the requisites of a standard, let us see how the standards which we have heretofore used for the measurement of light (because that is the thing which we really buy and sell) will bear the application of these tests. That is, are our standards really correct according to the tests to which we have now subjected them? I might, perhaps, emphasize this point by calling your attention to the standard of length, which is the standard best known, because the most common, and which possesses nearly all of these requisites. For instance, in this country we have a standard yard, as our standard of length. Everybody knows that a standard yard is practically the same at all times and at all places; although it is an interesting fact that perhaps even that is not strictly true, for we are beginning to suspect, beginning to know, in fact, that even a bar of metal, such as platinum or iridium, will not always and for ever remain at exactly the same length. Therefore, when we come to very accurate and precise measurements we must watch even our standards of length; but, practically, we may assume they are the same in time. And it is also very easy to make them the same in place, because our standards of length can be so readily copied, and the copying is such an inexpensive operation, that we may be practically certain that the yard found in Chicago is the same as that found in New York.

The ease of the application of the standard of length of course everybody understands. Now, what you want is to find a standard of the same kind for the thing which you sell, and which we buy—that is, a standard for the accurate measurement of light. Let me remind you that it is not many years since we were busy, in the interests of science, in the selection of standards. We are constantly having new things coming up requiring to be measured. So that this is not a problem which is new to scientific men. In the selection of a standard our first endeavor should be to find a standard of the same kind as the thing to be measured, although that is not always necessary. For instance, I may remind you that we very frequently measure the distance between two points (in a rough sort of way) in hours. Now, time is not distance, yet, if I ask you how far it is from here to New York city, you will very likely tell me that it is 24 hours. That is a very common way of measuring distance. And so there are other things in the measurement of which we are obliged to use a standard which is not of the same character as the thing measured; but we do not ordinarily do so, for in measuring length our standard is a length; in measuring masses our standard is a mass; and in measuring volumes our standard is a volume, etc. Therefore, in measuring light it is very desirable that our standard should be a light. But I have some serious doubts whether we shall ever be able to establish a standard for the measurement of light, which is itself a light. I am beginning to think we shall be obliged to resort to this kind of indirect measurement, which I have referred to, for measuring light. When it first came to be necessary to measure light (and that necessity practically arose in connection with the gas industry), it was very natural that the standards then selected should be those which were at hand.

The history of all standards bears us out in that proposition. For instance, you are all aware of the fact that our yard, which is now a very rigorous and exact standard for the measurement of lengths, was originally selected as being the length of the arm of one of the kings of England; and the hand, which is usedto-day to measure the height of horses, was originally the breadth of some man's hand; and I might give you many illustrations of that kind. These instances show a tendency to select, as a standard of measure, something which is at hand, and also something which has a natural origin. A good many years ago it was thought, by those interested in the science of measurement, that we might establish a system of natural standards. That would be very convenient, and some people are still struggling for that sort of a system, but have not yet reached it. By a system of natural standards, I mean a system based upon something invariable, which is found to exist in nature. Thus, if we could find anything in this world which was of an invariable length, and if we knew it was of an invariable length, we could base our standard of length upon that. If we could find anything which we knew was an invariable mass, we could base our standard of mass upon that. I need only refer to the history of the metric system, which is the most perfect system of weights and measures to-day, and which was originally thought to be a natural system, but has since been proved to be not a natural system, being now regarded as purely arbitrary. In the matter of the selection of a natural system of measurements, I may say that the direction of thought to-day, among scientific men, is really along the line of work in which you are interested. That is, it is quite possible we shall yet find our unit of length for all measurements, both great and small, in the wave length of a beam of light; that is, of light of a particular color. That is the direction in which investigation is now going. Some very able scientific men are now engaged in the endeavor to measure the wave length of certain lights with such accuracy as will enable them to accept that as the absolute standard of length. So you see that the standard of length may yet be very closely related to the luminosity of a gas jet, or of a candle.

Another of the important requisites or features of a standard is that it shall be linked in some way with all other standards, so that it can be readily converted into another, and we may easily go from one to another. Modern investigation of the law of the conservation of energy has taught us how we can transmute one form of energy into another; and, therefore, we can measure heat, not alone by degrees of temperature, but by foot-pounds of work produced; and we can also measure light by foot-pounds of work. So that in selecting a standard for light, it is desirable to select one which can be readily and easily linked in with other standards.

Table of Standards.

A very hasty review may be made of some of the standards that are already in practical use, in measuring quantities of light, and with which I suspect many of you are already quite familiar. I

have here a table of them (which, I may say, is abstracted from Wagner's *Chemical Technology*) in which you will see compared with each other the six light standards, which, perhaps with one exception, are very generally used. With regard to this one I want to say a few words before calling attention to the table. I refer to the platinum standard of light. You will remember that a few years ago it was thought desirable by almost all civilized governments to appoint an International Commission on the subject of standards of electrical measure. In that Commission the United States was represented by two or three of our most competent electricians. The Commission held several meetings and finally united on certain standards for electrical measurements, such as the "ampere" for current, and "volt" for potential, etc. Among other things which they attempted to do was to fix a standard for the measurement of light, as that was a thing which was recognized to be of the highest importance, because electricity was going into light production, and, therefore, a standard of measure was necessary. The standard of light which they suggested and adopted about 1884 has never been generally accepted in this country—indeed this country has never yet taken action, by its government, in accepting the electrical standards which were established by that Commission. By a sort of convention or agreement among electricians and business men who deal in electricity, or its use, the terms "ampere," "volt," and "watt," for measuring electrical currents and energies, have been generally adopted; but the Government has not accepted them by the passage of any legislative enactment.

The naming of the platinum unit as a standard of light was a serious disappointment to all who gave the subject careful attention; and for two reasons. The principal objection to its use was the great difficulty attending its production—a difficulty so great that probably it has only been produced by one or two men. It is also a very expensive operation, and one requiring very careful manipulation.

The platinum standard is the quantity of light which is radiated from a surface (one centimetre square) of pure melted platinum, at the temperature of solidification. If you will imagine a little square centimetre of pure platinum brought to the melting point (which is at an exceedingly high temperature, and, therefore, the incandescence is very great), the light emitted from that square centimetre of fused platinum is the platinum standard of light. Of course, we must proceed with great care; because if that platinum be hotter than its melting point the light emitted will be greater; if below the melting point it will be less. In order to establish the light as a fixed quantity, therefore, it is designated as the light which is radiated from a square centimetre of platinum at the melting point. This is obtained by raising the temperature of the platinum above the melting point, and then allowing it to cool. By photometric processes, the light radiated from that platinum is measured constantly, and as the platinum cools that light is found to be growing less and less all the time, until, finally, the intensity of the light stops diminishing and for some time remains stationary; and it is the light radiated during the time at which it thus remains constant that is the platinum standard. By and by it solidifies, and then the light grows very much less. This platinum standard, as I have stated, is one very difficult to realize. Another objection to it is that it does not link itself in with any of the other standards. We have no way of reducing the platinum unit of light to amperes, volts, or watts; and we have, therefore, no easy way of expressing the amount of energy which it represents. I do not, therefore, believe that the platinum standard will come into use to any great extent.

	Carcel, Schilling.	Carcel, Violle.	Platinum Unit, Violle.	French Stearin Candle, Violle.	German Union Paraf. Candle, Schilling.	German Union Paraf. Candle, Violle.	English Sperm Candle, Schilling.	English Sperm Candle, Violle.	Munich Stearin Candle Schelling.
Carcel	1.	1.	0.481	7.75	7.607	7.89	7.435	8.91	6.743
Platinum Unit		2.08	1	16.1		16.4		18.5	
French Stearine Candle		0.130	0.062	1		1.02		1.15	
German Union Candle	0.132	0.127	0.061	0.984	1	1	0.977	1.13	0.887
English Sperm Candle	0.134	0.112	0.054	0.870	1.023	0.886	1	1	0.907
Munich Stearine Candle	0.148				1.128		1.102		1

Table of Standards.

This table shows the relations of the different standards already referred to. You are all probably familiar with these relations, but the table is to me a striking illustration of the confusion which exists among us with regard to this matter at the present time. For instance, compare the platinum standard with all the others, as found in this column. The platinum unit appears to be about 2.8 times the carcel lamp, it is about 16.1 times the candle power of the French stearine candle, and 16.4 times the candle power of the German paraffine candle; from which it would seem that the French and German standards agree quite closely with each other. The English spermaceti candle, which burns 120 grains of pure spermaceti per hour, is a well-known standard of candle power. The platinum standard is 18.5 times that candle power. If we could only use this platinum standard it would be a most convenient unit, to which both the incandescent lamp and the gas burner could approach; because a gas jet which gave one unit of light, according to the platinum standard, would give, say, 18.5 candles by our present standard. A study of this table reveals differences of 15 or 20 per cent. in the results obtained by skillful observers.

Perhaps it may be interesting to take a moment to more particularly describe these standards, as some of them may be new to some of you.

The German paraffine candle is 20 millimetres in diameter; and 12 candles weigh one kilogramme. The wick is composed of 24 cotton threads, such that, when dry, one metre of the wick weighs 0.668 grammes. A red thread is introduced to distinguish it from other wicks. The paraffine must solidify at a temperature not below 55° Centigrade. The height of the flame must be 50 millimetres.

In the Munich stearine candle, the stearine must contain between 76 and 76.6 per cent. of carbon. According to Schilling, the candle burns 10.4 grammes of stearine per hour, when the height of the flame is 52 millimetres. The requirement that the stearine shall contain that percentage of carbon is an important consideration, because it is well known to most of you that it is possible for you to make even a standard candle vary, according to the composition of the stearine, so that it shall work in favor of the gas company, or in favor of the consumer, by as much as 14 per cent.; so that if you grant your photometric process to be correct, you can still see that the variation caused by the difference in the composition of the candle would be greater than would be permitted in any other kind of measurement.

The English spermaceti candle is well known. Its wick is of three strands, each of seventeen threads. It burns 120 grains (7.78 grammes) per hour, and the height of the flame is 45 millimetres.

The French carcel lamp is probably well known. It burns 42 grammes of rape seed oil per hour.

The Hefner-Alteneck lamp has a solid round wick, burning amyl-acetate. The wick is placed in a tube of German silver, 25 millimetres long, 8 inner, and 8.2 millimetres outer diameter. The flame is 40 millimetres high from the edge of the tube, and measured at least 10 minutes after lighting. Provision is made for protection with a chimney in case of draughts, with a corresponding correction. It about corresponds to the English candle with a flame 44 millimetres high.

The platinum unit I have already described.

I think that a simple inspection of this table is sufficient, without the necessity of speaking further upon it. From it we see that we are in the possession of one standard for the measurement of light which is theoretically quite good. This platinum standard is one which certainly possesses the first requisite that I spoke of; it is constant. I suppose that the amount of light radiated by a platinum standard will be the same 100 years from now, as now; the same in one part of the world as in another; it is constant, as no candle or lamp can be. But it does not conform to the other requisites, in that it is not convenient, and cannot be produced or applied easily.

The Difficulty of Photometric Measurement.

It may be desirable to say a few words with regard to the cause of some of these difficulties in the way of photometry, although I suspect that the cause is one well known to all of you. It lies in the peculiar fact that the article which is to be measured is a thing which is not constant in its quantity, is uncertain in its nature and composition, and is not of any known or definite character. I might say that this measurement of light aside from the uncertainty of our standards to which I have referred, is somewhat like an attempt to measure a sheet of elastic rubber which

was subjected to various degrees of tension—at one time stretched and at another time contracted. That would be bad enough, even if you applied a simple yard stick as the standard by which to measure the rubber, because you have a variable thing to measure; but if at the same time you applied a yard stick which was itself also of rubber, and tried to make an application of such a unit to such a material, you can imagine the very great variation there must be in the results of every such measurement. It is, therefore, necessary for all persons interested in the measurement of light to define what is the nature of the thing measured. That is the difficulty. We talk as if there was such a thing as a white light; but you have all learned long ago that white light is a thing which is exceedingly indefinite, and has no meaning. There is not any kind of light which is the same at all times. There is no source of light so far as we know which appears to be absolutely the same at all times and under all circumstances. We usually speak of the sunlight as a white light; and yet the light of the sun as it reaches us is varying constantly in its constitution and character. Doubtless, many of you are aware of the fact that Professor Langley, now Director of the Smithsonian Institute at Washington, carried on a very valuable series of researches in connection with the character of the light of the sun; and he rather astonished the non-scientific public by announcing that the sun was not white, but that the light of the sun really was blue; and that if it were not for the absorption to which the sunlight is subjected in passing through the atmosphere, the light of the sun would look blue to us, or more like the violet in the electric light spectrum. There is no question but that is the fact. We get the sunlight after it is sifted through an enormous mass of absorbing material; and even the absorbing material through which the sunlight passes is by no means constant. Every one has seen an illustration of that fact when he has seen the sun looking red in the morning and in the evening, because the yellow, white, green and violet rays are absorbed by the atmosphere. So that even the sunlight is not available as a standard of light. Therefore, the problem which I first suggest is an accurate definition of what light is—that is, the kind of light that we use. What kind of light do we want to produce, or sell, or buy. That, I think, must be first defined. After that is defined we can proceed, I think with some success, to provide means for the accurate measurement of light, and I hope, in your hands, for the production of that light. And that leads me to consider another feature of this question—

The Energy of Illuminants.

Light is only a form of energy, just as heat is a form of energy. I invite your attention to this point, because I believe that it is through the consideration of light as a form of energy we shall eventually find success; and only in that direction. Hence I want to speak briefly of the energy of different sources of light. You will understand, I suspect, without any explanation from me, what I mean by that. The energy of a body is the quantity of work which it will do. The energy of a candle when burning is the quantity of work, the foot-pounds of work which that candle would be able to accomplish, if all the heat produced could be converted into work. We can measure this energy without great difficulty by a certain process, which I will not stop to describe. I have gathered and calculated, within a few days, a few results, some of which may be of interest. For instance, taking a common stearine candle (which is the standard candle for gas photometry) we find that the energy of that candle is such that 8.77 of them are equivalent to one-horse power. I confess that I was rather surprised, when I found that the energy of one candle was so enormous as that. But it cannot be very far from the correct result. Whenever we see 9 candles burning, an energy amounting to one-horse power is there being wasted. Of course we are getting back some of it in the shape of light. The true economy lies in the direction of getting more of this energy in light, and not so much of it in heat. A spermaceti candle gives a similar result—8.97, or nearly nine candles per horse-power. Of course the composition of coal gas is variable, but taking the average composition of gas, and we find that five cubic feet per hour (which ought to give you 15 to 16 candle power) is equivalent to 1.2 horse-power. That is another result which is rather surprising. That is, for every jet of gas you have here, burning five cubic feet per hour, you have 1.2 horse-power. That is the amount of energy being wasted You get back some of that in light; but not nearly all of it. We get it back at the rate of 13 candles per horse-power. Observe that a common candle gives you about nine candles per horse-power, while your gas jet is a little better; it gives you 13 candles per horse-power. That is an improvement, but not so great as it ought to be. We may go further and give some results with regard to electricity. It is known that one horse-power may maintain ten 15-candle power incandescent lamps. From that we find that when electricity is consumed in that way (converting its energy into incandescence) we get 150 candles per horse-power. When converted into the arc light we get from 1,000 to 1,500 candles per horse-power. Thus we see that in candles we have 9 candles per horse-power; in gas we have 13 candles per horse-power; and in electricity we have—in the incandescent light 150, and in the arc light from 1,000 to 1,500 candles per horse-power. There is, therefore, a real and decided advance in the direction of converting this energy into the kind of energy which we really wish.

I will say just a word here with regard to the matter of availability. You must not understand that I mean from these figures that an arc lamp is 100 times as economical or desirable as gas, or as the common candle, although it seems to give 100 times as much light per horse power. The question of availability always comes in. We pay a very high price for "energy" if we want it badly, and if we can get it just where we want it. For instance, you step into the telegraph office, and you say to the operator, in effect, "I wish to transmit a little energy to the city of New York;" and you pay for the transmission of that energy at the rate of 25 cents for 10 words. I have figured that out, and I find that you may thus pay for energy at the rate of about $100,000 per horse power. But you do not object to that price, because you want the energy, and you want it in New York. You have it here, and you want to put it in New York. So I say that availability is a consideration always to be taken into account.

Energy of Vision.

Recently, Professor Langley has been working in the direction of finding out just what kind and amount of energy must be used in order to produce vision. The results obtained by him are extremely interesting. This is a little chart showing the distribution of energy as far as the production of vision is concerned. I will first explain how the chart was made. The figures from which the chart is prepared were obtained from Professor Langley, who is still pursuing his investigations along the line of light and radiation. A few weeks ago he gave them to me saying that they had been hastily reduced, and he would not guarantee them to be correct; but they are approximately correct, and they show results which are exceedingly interesting. Professor Langley wanted to determine what horse power was necessary to produce vision; or what energy was necessary to produce vision; what was the minimum, and also where that energy would be best located. As you understand, we can have energy in a great variety of forms. You can have it in the shape of the blow of a steam hammer, but I might have that steam hammer working away for hours and nobody could see it operate; there is no light produced. But if I begin to work it more vigorously I begin to convert some of that energy into ether waves short enough to produce vision; the iron underneath the hammer becomes hot and begins to glow with a red heat. If I pound still more vigorously, I produce shorter and shorter wave lengths until finally the eye is affected more powerfully than it was in the beginning. If I go on I pass the maximum; and beyond that point, if I keep on still shortening the wave lengths, Ido not increase their efficiency as producers of vision. So the question to which Professor Langley addressed himself was this: How much energy is necessary to produce the sensation of sight, and where must that energy be found? That is, what must be its wave length, where in the spectrum as we ordinarily speak of it? He has answered this question, at least approximately. To do this he took a small quantity of energy—and it will astonish you to know what a small quantity of energy will produce vision. We are now measuring light by horse power; and we must continue to do that. I believe that eventually your gas bills are not unlikely to be sent in for so many horse power per hour, instead of for so many cubic feet of gas; because we do not want gas, but light. Professor Langley has found that when in these measurements he used a constant quantity of energy which was amply sufficient to produce the effect of vision all the way through—that is, when it was red light, when it was yellow light, when it was green light and when it was blue light; the quantity which he used was only one-three-hundred-millionths (1-300,000,000) of a horse power. He found by experiment that a quantity of energy which is so small that it is represented by the fraction 1-30,000,000,000,000,000

of a horse power is sufficient to produce vision. In making these experiments he used the quantity represented by 1-300,000,000 of a horse power and, in effect, first made it appear as a very dark red light; then as a lighter red light; then, by-and-by, as orange light; then as yellow; then as green; then as blue; and so on through the whole spectrum. That is a very simple, and yet a very elegant experiment—to take the same quantity of energy and put it through all the wave lengths, and see how it affects the eye, in order to find out just where the energy should be placed in the spectrum in order to be the most effective. This curve which I have here shows the result of that test. Here is the scale of the spectrum made below, by which you can see that the energy of the red is almost absolutely useless, and that the energy of the violet is almost absolutely useless. You do not want that; but you do want it somewhere along between the yellow and the green. The figures show that the light produced at a point between the yellow and green, in the normal solar spectrum, or the energy put into light of that wave length, will produce more than one million times the effect on the eye that it will if put in down in the red, or if put in up in the violet. It seems to me that is an exceedingly important lesson. That is, if we are buying and selling energy (for that is the thing worth money to-day in the world), if we want to make light of it, we want to learn just where to put it—just what wave lengths to put it into; and that is to be determined very largely by the degree of incandescence. I simply state the problem. Just how it is to be solved of course I am not able to state.

The Problem.

It seems to me not impossible, Mr. President and gentlemen, to state the definite problem which now lies before those who are engaged in the study of this subject of the production of light; and perhaps I cannot do better, in closing what I have to say, than to attempt to make a clear statement of the question.

The future of this question seems to me to be practically this: We must first determine what species of radiant energy is most desirable. It seems to me that the result of these experiments made by Professor Langley is an important step in that direction, and goes far to determine what species of radiant energy is desirable. That is, we want the energy from within narrow limits in the spectrum. The next thing to be done is to find out how to produce that particular species of radiation and exclude every other species of radiation—up in the violets and down in the reds. We do not want that which is not useful as light. The next thing is to determine how to measure accurately this energy when put into the form of radiation.

I think that scientific men will undertake to help you solve parts of this problem. When you or they determine just what species of radiant energy you want, they will help you to determine how to produce that particular species of energy, and how to exclude every other; and then will undertake to measure that energy for you. It will then remain with you to solve the remaining part of the problem, and that is to determine how to produce this most desirable species of radiant energy at the lowest possible cost to the consumer.

Discussion.

The President—If we had the time we should be glad to surprise the Professor by showing him that each and every man here could take up the subject of his lecture, analyze it, and discuss it thoroughly. But we have but a short time, and can listen to but few remarks.

Mr. King—I cannot say how much I have been gratified by listening to the Professor's remarks; especially as, for at least two years, I have been working as far as I could in just that line. I have believed ever since this question of candle power and illumination came up that platinum would finally be adopted as the standard. I do not know but that I have suggested that idea. I have had several conferences with men who have given spectrum analyses, and have paid considerable attention to the subject. My idea was the relation of the different colors of the spectrum to each other. Another idea (although I have not gone far into the matter) was the attacking of certain chemicals by the energy of different lights. That is something I have not thought so much about. There is one question I would like to ask the Professor (I do not know what papers our President has sent him), but in the discussion of this subject of candle power and of illumination the question has come up several times. Some have thought that it took two jets of water gas to illuminate a room as much as one jet of coal gas would do; and yet the photometer would show to the contrary. That question has been brought up again by some experiments made by our President in his laboratory with the new burner—the Welsbach. The burner that everybody pronounced the best (as giving the most beautiful light), has, I understand, actually shown in the photometer but about half the illuminating power of the other light. I wish to ask the Professor whether he has looked into this question of candle power versus illumination; and, if so, what would be his idea on the subject. I mean, as to the diffusiveness of light from a source that may be brilliant, as to carrying or diffusing the light to any great distance.

Prof. Mendenhall—I may say, very briefly, in regard to that, that I have been much interested in the point raised in connection with this question. I believe myself that the solution of the problem lies along the line which I have indicated, when we shall determine just what components of light are the most desirable components; just what spectrum components, or wave lengths, are desirable in a light. It is easy to see that there will be very often a wide difference of opinion and of practice. For instance, in interior illumination, such as the illumination of a hall tinted as this hall is, there would be required for the best illumination a light of a different character from that which would be required in a hall differently tinted. In other words, the absorption properties of the wall of a room will influence the result a great deal. I should not be surprised to know that such a result as you indicate had actually occurred with regard to relative photometric values. I would like to add that I was much interested in the statement made by Professor Langley in speaking of his research with reference to the photometer which he used. The first question I asked him when he spoke of candle power was, what photometer did you use for comparing the intensities of these lights? He told me that he had tried every kind of photometer, he believed, that had ever been suggested, but that he finally came back to this—which I am glad to suggest to you, as it may be of some service in your experiments. I have myself tried it with considerable satisfaction. He said, "I come back to reading a table of logarithms." What he meant was that a table of logarithms happened to be the particular kind of print that was convenient. In other words, he took a printed sheet of paper, having rather small figures over the surface of the paper, covered it over with a piece of paper so as to allow an exposed surface of a square inch; and that was the thing with which he tested the light; finding out with what amount of light he could read the figures distinctly. That was his photometer.

ELECTING THE PROFESSOR TO HONORARY MEMBERSHIP.

Mr. Jenkins—In order to show in some slight degree our appreciation of the interesting lecture to which we have listened, I think we will all take pleasure in placing the name of Professor Mendenhall upon our list of honorary members. I move that such action be taken.

Unanimously agreed to.

A LETTER FROM PROF. DOUGLAS.

The Secretary read the following letter from Prof. Douglas:

"ANN ARBOR GAS LIGHT CO.,
"ANN ARBOR, MICH., May 7, 1888.

"A. W. Littleton,
"Sec'y Western Gas Association.

"Dear Sir:—I am very sorry that my poor health will not permit my attendance at the meeting of the Association this year, which I hope will be an exceptionally pleasant and profitable one.

"The gas business remains as good as ever in Ann Arbor. During the winter I have been using Lima crude oil, in place of coke, under our benches, with very good and economical results.

"We cover our grate bars over with coarsely broken fire brick, closing up all draughts, and insert the burner in a small hole made by removing a brick just over the door. Our financial results are as follows—duration of test 24 hours, benches of 3 retorts:

"Coke used as fuel, 32 bushels, at 10 cents per bush. .	$3.20
"Oil " " 150 gals., at 1½ cents per gal. . . .	2.25
"Balance in favor of oil	.95

"But the economy does not end here. The heat may be kept exactly the same, avoiding the evil effects on benches of changes in temperature. There is no chiseling away the fire-box in attempts to remove clinker, and the labor of stoking is decreased materially—the oil requiring very little attention.

"The burner we use is constructed on the concentric principle, consisting of two concentric cones. The inner cone carries the oil, and across the mouth of this the steam is projected at such an angle that the mixture may be complete and the spray fill the entire combustion chamber with a mass of smokeless flame. This is accomplished by the relative angles of the inner and outer cones. Hoping our experience may be of interest to the Convention, I remain,

"Yours truly,

"SILAS H. DOUGLAS."

APPOINTING SPECIAL COMMITTEES.

The President then named the following special committees:

Committee of Arrangements, Meeting of 1889.—Messrs. H. Ranshaw, W. S. Howell, J. H. Phillips, J. M. Murphy, J. M. Skinner, J. R. Keenan and Henry Felt.

Committee on Procuring a Suitable Permanent Badge.—Messrs. E. J. King, F. Egner and A. W. Littleton. [This committee was appointed in consequence of a motion (made by Mr. Lansden) suggested by the President, who urged that it would be wise to have a suitable permanent badge, and so abate the continued annual expense attendant upon the designing and purchasing of a badge for each yearly meeting.]

On motion, Mr. George Shepard Page was appointed to draft a letter expressive of the hearty wishes of the Western Association for the complete success of this and coming meetings of the British Gas Institute. [Mr. Page, who is now in Europe, will present the letter thus authorized at the current meeting of the Institute.]

PRINTING THE PAPERS.

On motion of Mr. Lansden, the Secretary was instructed to have the papers (to be read next year) printed in advance of the meeting, the Association to bear the expense.

VOTES OF THANKS.

On motion of Mr. Dunbar, the thanks of the Association were heartily tendered to President McMillin for the impartial and business-like, as well as thoroughly courteous manner in which he conducted the transactions of the sessions. In responding to the vote the President said:

Gentlemen:—I am under obligations to you and so should offer my thanks to you instead of receiving any myself. I never presided over any organization where I enjoyed myself more than I have on this occasion, and I have never presided over a more intelligent body. I think we have the most intelligent assembly here this time that we ever had. Indeed I might go further and say that it is the most intelligent gathering I have ever seen assembled in a gas association, and that is saying a good deal to men who attended the Ohio convention. The fact that this meeting has been successful is chiefly due to our Secretary and our Vice-presidents. Your President, really, has not done much, if anything, to secure such success.

On motion of Mr. King, a hearty vote of thanks was tendered to Secretary Littleton.

On motion of Mr. Egner, the thanks of the Association were voted to the local Committee of Arrangements for the handsome manner in which their labor of love had been performed. Mine host, Kinsley, also came in for congratulation, whereupon the Association adjourned.

New Petroleum Engine.

The *Scientific American* notes that interesting reports have been presented on Messrs. Priestman's engine by Sir William Thomson, F.R.SS.L. & E., LL.D., M. Inst. C. E., Sir Samuel Canning, M.Inst. C.E., Boverton Redwood, Esq., F.I.C., F.C.S., and by Messrs. H. Alabaster, Gatehouse & Co.

Sir William Thomson says: I have inspected Priestman's petroleum engines (made under Priestman's, Humes', and Eteve's patents), at their works, Holderness Foundry, Hull, where I found six engines all working with common petroleum, of gravity about 800. In one shop I saw a 4 horse power petroleum engine doing ordinary duty in a perfectly satisfactory manner, I am informed, in place of a semi-portable engine and boiler, which has now been entirely dispensed with for some months past.

Another shop, containing lathes, etc., is being driven constantly by a smaller engine. This is similar to another engine supplied by the makers to Messrs. Richardson Brothers, of Newcastle, which I had previously inspected in Newcastle, and found working very satisfactorily. A small double cylinder engine has been mounted upon a truck, which is worked on a temporary line of rails, in order to show the adaptation of a petroleum engine for locomotive purposes, on tramways, and in my opinion there is a great future for this engine in that important direction. I was shown a launch in progress, designed for being driven by petroleum, the engines for which were also in hand.

The exemption from boiler and "getting up steam," and from need for fresh water supply for the boiler, and the smallness of the weight of the fuel in proportion to duty done in Messrs. Priestman's petroleum engines, and the convenience for stowing the oil in tanks in the bottom of the boat, give what seem to me important advantages to these engines in comparison with steam engines for launches and small steamers in many places, and for varied applications. I made careful tests on a 6 horse power engine. After seeing it started and stopped several times, and kept running on the brake for an hour at 7¼ horse power, and for two hours at 6 horse power, without measuring the oil, I gave it exactly an hour's run with the brake loaded slightly more than 6 horse power, and with arrangements to measure the oil accurately.

The result was that the engine ran with very admirable regularity at from 158 to 160 revolutions, doing 6.43 horse power on the brake. The quantity of oil used was very exactly 11 pints, being at the rate of 1.71 pints per hour per brake horse power, or 1.69 lb. per hour per brake horse power, which seems to be remarkably good economy, considering the great difficulties which had to be overcome in using the combustion of oil directly as a motor. It must be noted that these results refer to the horse power of work actually done externally by the engine, and not merely to "indicated horse power," which in the steam engine, and still more in the gas engine, falls short of true horse power by a large difference.

Messrs. Priestman's engine, unlike one upon another system to which my attention has been called, does not use only the lighter portion of the oil, leaving a large residuum which cannot be utilized, but has the great advantage of consuming the whole of the oil put into the cistern, which I verified by careful examination of the working of the engines which I tested. Mr. Priestman's engines are simple in construction, and there are few working parts liable to get out of order. By a new and effective mode of regulating the supply of vapor to the cylinder, combustion so perfect is obtained that deposit of carbon in the cylinder and passages is most satisfactorily obviated, as I have myself verified by careful examination. As the engine is governed by reducing the charge admitted into the cylinder, instead of cutting off the supply, the explosion takes place with great regularity, thus securing steady running with or without load, and with varied loads, which, judging from my own experience of the irregular running of gas engines running at anything less than full load, is a very important advantage. Some of Messrs. Priestman's engines are fitted with a combined circulating water tank and pump, obviating the necessity of having a separate tank with over-head piping, which, in many cases, is objectionable. The piston requires no oiling, as the vapor admitted into the cylinder lubricates it sufficiently. As this engine has all the advantages of a gas engine, without being dependent on gas works and a gas supply, it is available for many important applications from which the gas engine is precluded.

THE *Gas World* says that the London gas companies are moving in the path of progress—that is to say, they are making serious efforts to cultivate business in fresh fields upon true business principles. Quite recently the Commercial Gas Company issued a circular to residents in its area of supply, in which special attention is drawn to two important points. It states that it is prepared to lay on gas in places where gas is not already used for lighting purposes, so that heating and cooking stoves may be introduced. This the Company will do free of charge, and then it will hire out stoves at moderate rates. Similar facilities are offered for lighting purposes. The Company intimates that it is prepared to provide and fit up lighting brackets and pendants on "terms much below what are usually charged;" and, of course, in this case, as in the case of stoves, the intending customer is not asked to pay for the service from the main. This is the most practical way of breaking down the barrier reared against the progress of gas-lighting by paraffin and oil lamps. The Gas Light and Coke Company is also pushing the stove business among its constituents. It offers inducements to hire or purchase stoves, but it says nothing about supplying services free of charge, nor does it make any announcement about providing fittings, although, we believe, it also opening up this branch of business. The three London companies have a wide field to cultivate. We trust the returns from increased consumption of gas will more than remunerate outlays. Some of the suburban companies would do well to imitate the example set by their larger neighbors.

The Market for Gas Securities.

Brokers are complaining bitterly of the state of trade in city gas shares. A transfer is a rarity, although prices seemingly are now at bedrock in all classes of local gas securities. To-day (June 14) Consolidated is at 72½, ex-dividend, of course, which is now being disbursed. Equitable has stiffened up a trifle, although bidders do not appear anxious to come closer than 5 points to the values set by holders. This stock ought soon to show a decisive move. It is bid for at 105, while holders demand 110. Probably a bid of 107½ would elicit free offerings. Mutual is not as strong as its business would seem to warrant. Brooklyn shares are dull and inactive, although the undertone to the market is of the bullish sort. We quote Fulton-Municipal at 133 to 135. Metropolitan at 80 to 82; Williamsburgh (which is exceptionally strong), at 122 to 125. On the 13th, at auction, $1,000 five per cent. bond of Peoples Company brought 100¼. Consolidated, Balt., is quite weak, having been offered down to 44, and local brokers predict still lower values. Chicago Trusts also exhibit a declining tendency, being quoted at 31 to 33. Eastern stocks are firmly held, and sales recently made in the best known classes—although the number of shares disposed of in each transaction is hardly worth accepting as evidence of standard prices—were all effected at much higher rates than those previously reported. This is especially so of Connecticut stocks. Southern securities are somewhat weaker, especially in the instance of old New Orleans.

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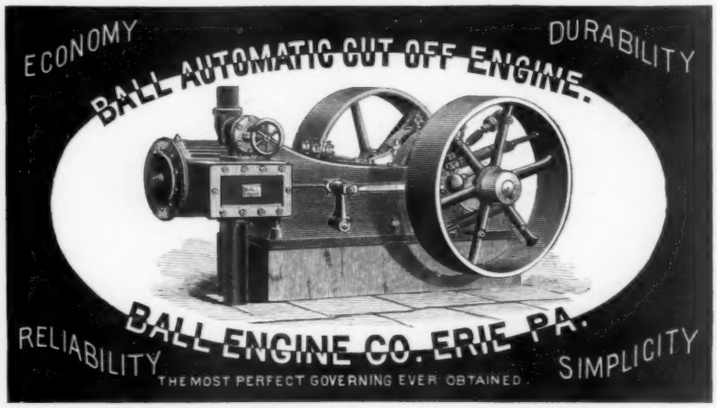

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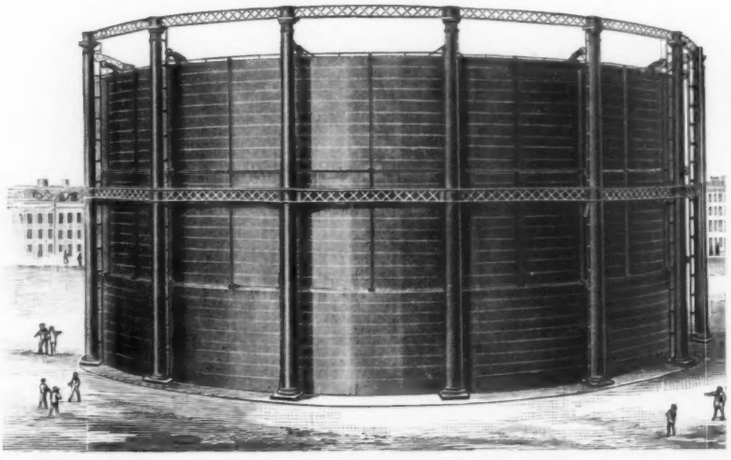

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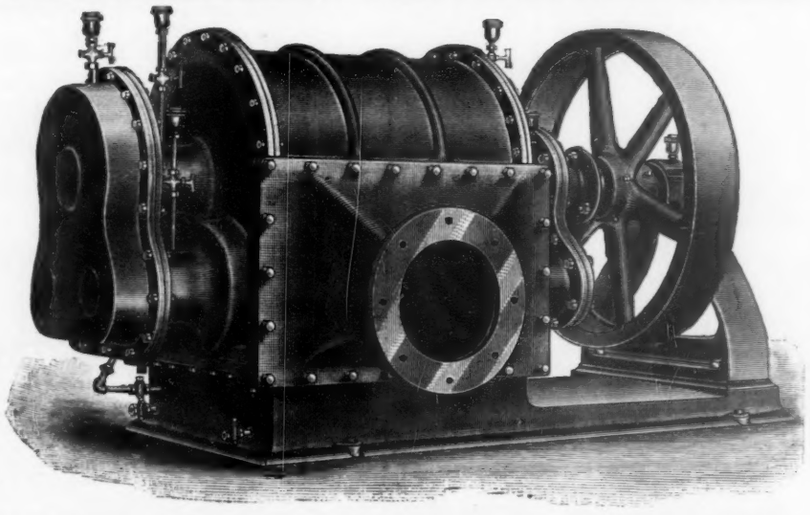

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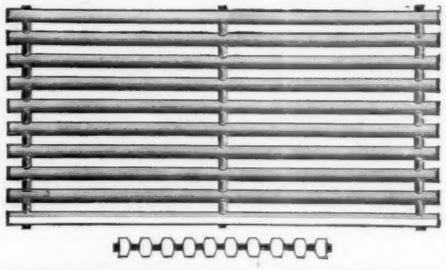

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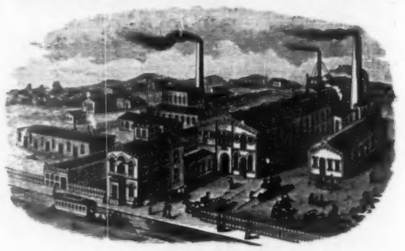

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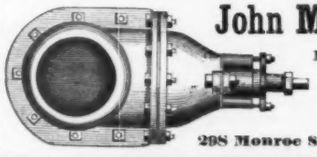

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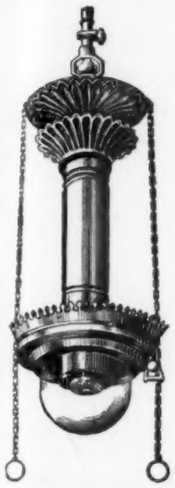

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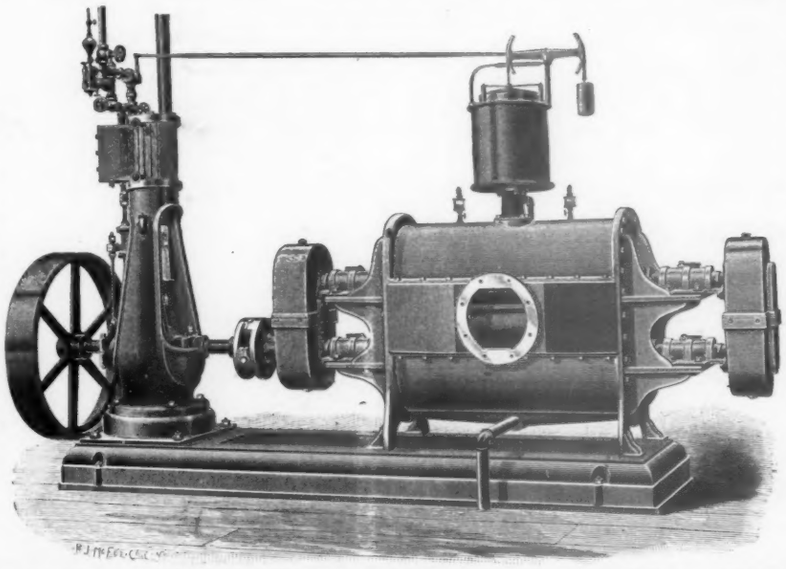

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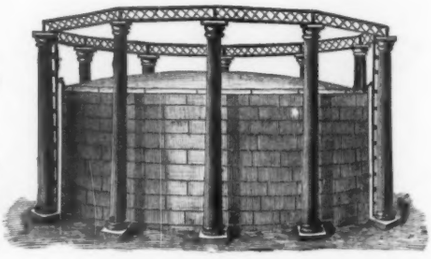

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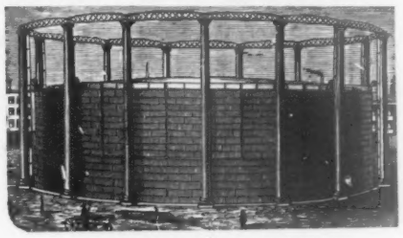
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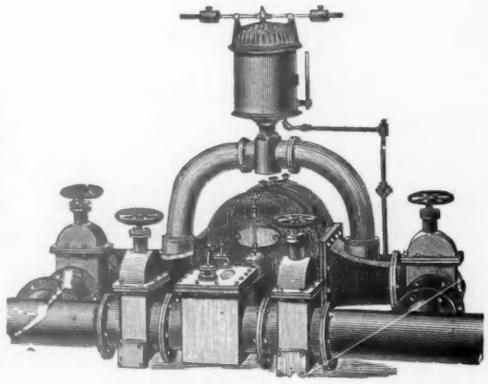

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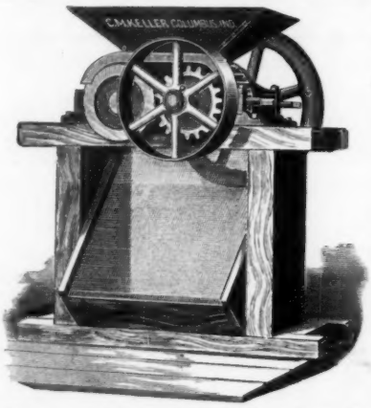

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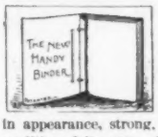

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50-H.P. STEAM ENGINE AND BOILER, Running a Plant of Fifty 2000-C.P. Arc Lamps 12 Hours.	
4,500 lbs. Indiana nut and slack, at $1.30 per ton	$2 93
Engineer, one night, at $50 per month	1 67
Trimmer, one day, at $40 per month	1 33
Superintendent or Electrician, one day, at $50 per month	1 66
Waste, etc., one day, at $20 per year	05
Water rent, one day, at $40 per year	11
Wheeling coal and removing ashes, at $4 per week	58
100 pairs carbons, at $18.50 per 1000	1 85
One pint cylinder oil, at 60 cents per gallon	07
One quart engine and dynamo oil, at 50 cents per gallon	13
Total	$10 38

50-H.P. OTTO GAS ENGINE, Running a Plant of Fifty 2000-C.P. Arc Lamps 12 Hours.	
9,200 cu. ft. gas, at 42 cts. per M. (for cost of gas see items below)	$3 86
Engineer not needed; engine is in care of Electrician or Supt.	....
Trimmer, one day, at $40 per month	1 33
Superintendent or electrician, one day, at $50 per month	1 66
Waste, etc., one day, at $20 per year	05
Water rent dispensed with (cooling water used over and over)	....
Handling of coal included in cost of gas	....
100 pairs carbons, at $18.50 per 1,000	1 85
One pint cylinder oil, at 60 cents per gallon	07
One quart engine and dynamo oil, at 50 cents per gallon	13
Total	$8 95

Expenses of depreciation, repairs, and interest omitted, being considered the same in both cases—though depreciation and repairs are much higher with steam on account of boiler and its appurtenances. Cost of gas in the holder we estimate for most of the Middle and Western States as follows: Coal, 30 cts.; labor, 20 cts.; purification, 2 cts.; total, 52 cts. Less coke, 7 cts., and tar, 3 cts.; leaving net cost of gas 42 cts. The items of Superintendence and repairs, being paid for by the gas sold to consumers, need not be charged on extra output for gas engine consumption. Where the cost of gas is higher than here figured, coal for steam use will be found proportionally higher, and final figures of comparison show same amount of saving.

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